COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XIII NOVEMBER, 1908 No. 11

READY OXYGEN MAKES ACETYLENE OPPORTUNITY*

By Cecil Lightfoot.

The application in the United States of the oxy-acetylene blowpipe to the welding of metals has not been developed at present to anything like the same extent that it has in England and on the Continent of Europe. This is no doubt because until within a comparatively few months there existed no satisfactory source of supply of the necessary oxygen. To some extent the absence until quite recently of any by-laws regulating the traffic in compressed oxygen and its transportation by rail, with the difficulty in cases of getting the traffic accepted at all, no doubt discouraged any serious effort to develop the trade.

Oxygen could certainly be obtained in most cities in the country, but its price was prohibitive for industrial application, while in most cases its purity was as equally problematical as nebulous. At that time the general practice in this country was to compress the gas to a pressure of about 250 pounds per sq. in. into riveted and brazed cylinders of steel or wrought iron, of diameter relatively large compared with the length. It is, however, essential that for economical results to be obtained on an industrial basis, the gas should be compressed to a higher pressure, as is now universally and without exception adopted in Europe, the construction of the cylinders being modified accordingly.

When in 1897 Dr. Carl von Linde succeeded in separating the constituents of the atmosphere by means of his method of air liquefaction and subsequent rectification, the solution of the problem of how to produce pure oxygen in large quantities and at a low price was realized. Now that the railroad companies have at length officially recognized the traffic in cylinders of oxygen under high pressure by the adoption of suitable regulations for its control, and with the establishment on an extensive scale of an oxygen plant by the Linde Air Products Co. at Buffalo with an output of many thousands of cubic feet a day, great impetus has already been given to the application of the oxy-acetylene blowpipe in this country. In fact, the development which has taken place in the past month or two has been most remarkable, and it may be predicted with certainty that welding by means of the oxy-acetylene blow-pipe will ultimately become a very important factor in mechanical engineering practice, and will be developed on a scale far exceeding anything that is now being done in Europe. It is almost possible to foresee the time when every machine shop and engineering establishment of any magnitude will be equipped with an oxy-acetylene welding plant.

Oxygen may, of course, be generated by chemical means on the spot, and indeed there are at the present moment a number of such small chemical plants in daily operation, with more or less success, in conjunction with oxy-acetylene welding equipments. A somewhat complicated and frequently uncertain chemical process is obviously entirely out of place in an engineering establishment, and it would seem that, other things being equal, it is far more rational for supplies of oxygen to be obtained, ready for use, from some outside source. Apart from the space occupied by such a chemical plant to produce oxygen, there are other disadvantages, among which may be mentioned the trouble of periodically cleaning out and recharging the retorts and the oxygen

*Proceedings International Acetylene Association, Chicago, August, 1908.

producing plant, necessitating a continual expenditure for labor, besides the wear and tear of the parts themselves, due to corrosion and burning out. In some cases, also, there is a very objectionable refuse to be disposed of. Furthermore, it must be borne in mind that the oxygen thus produced is by no means pure, and requires filtration and scrubbing before it can be used. It has then to be compressed, necessitating not only some source of power but a continual repacking and renewal of working parts from time to time

It is true that attempts have been made, so far without very marked success, to generate oxygen under pressure by chemical means, but it is obvious that the results obtained in this way must be uncertain, apart from any question of risk. The possibility of the deterioration of the raw material with age and exposure must also be taken into consideration, this being quite an important factor in many cases.

It will thus be seen that the generation of oxygen by chemical means is a considerably more involved process than the production of acetylene, and it is self-evident that unless oxygen can be obtained ready for immediate use without the complications attendant on the running of a chemical plant many engineering establishments will have diffidence in taking up the welding process.

Recognizing all this and that there must be a growing demand for oxygen if it can be supplied to the consumer under high pressure ready for immediate use and in a convenient and portable form, the Buffalo works of the Linde Air Products Co. have been established on a very large scale indeed. With an equipment of cylinders which runs into many thousands the company is now prepared to supply every possible demand.

The oxygen supplied by this company is guaranteed to contain not less than 95 per cent. of pure oxygen, the balance consisting of the ordinary nitrogen constituents of the atmosphere. It is shipped under high pressure in solid-drawn, seamless steel cylinders of special construction which comply with the amended railroad classification regulations. For industrial application the largest size of cylinder, which contains 100 cu. ft. of oxygen under a pressure of 120 atmosphere, is most convenient. Furthermore, with a view to minimizing the delay arising from long freight hauls and insuring prompt delivery of cylinders containing compressed oxygen the company have introduced an "exchange-sale" system. For the convenience of the company's clients who have purchased cylinders from them—thereby obtaining the benefit of reduced rates and avoiding rent charges—the company will, if so desired, supply "full" cylinders on receipt of bills of lading covering the return of an equal number of similar "empties," providing the latter have been despatched freight prepaid.

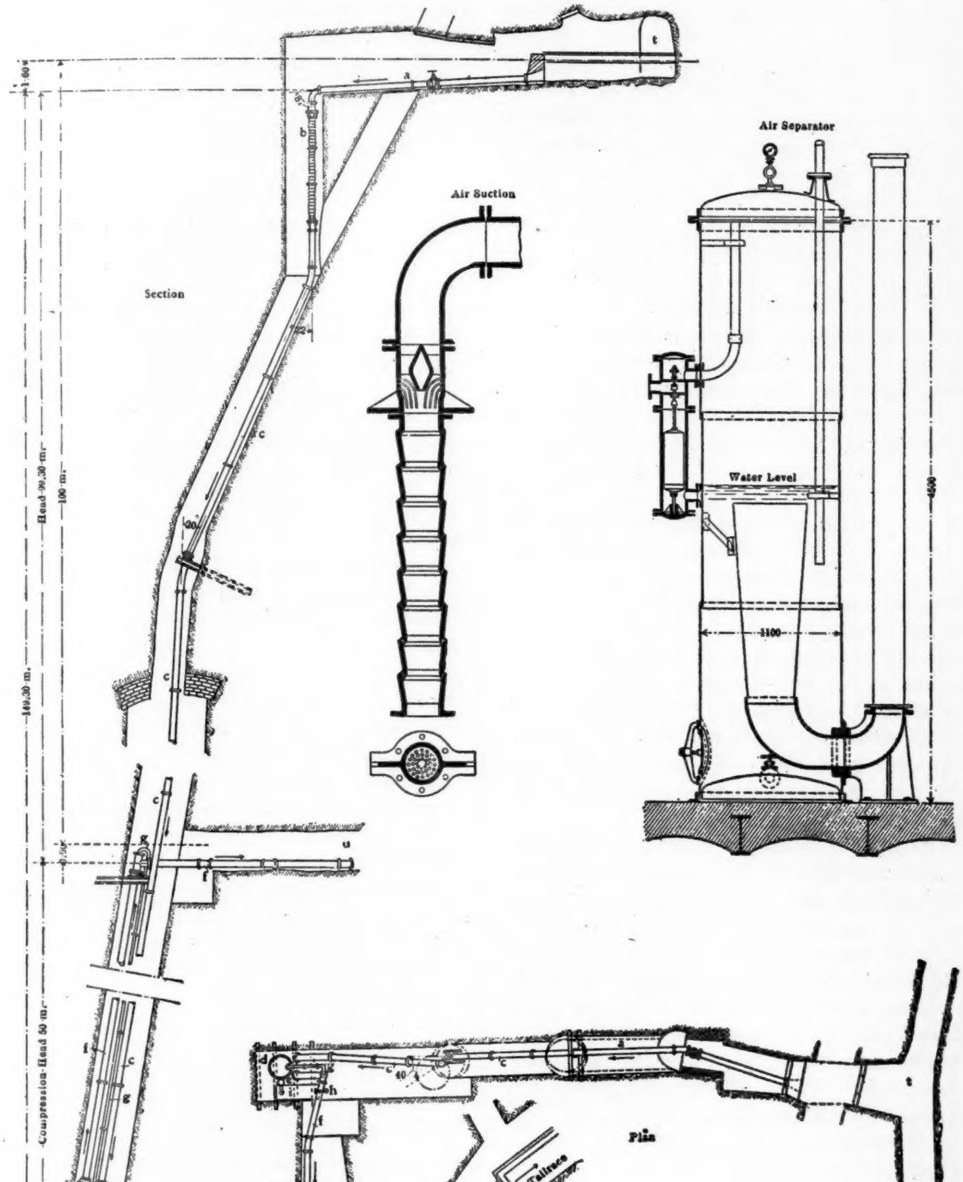
HIGH EFFICIENCY OF A HYDRAULIC AIR COMPRESSOR

P. Bernstein in *Glückauf* describes and discusses the operation of a hydraulic air compressor recently installed in one of the mines at Clausthal. It replaced a piston compressor driven by a Pelton wheel, and effected a marked saving in running expense. For the following abstract we are indebted to *The Engineering and Mining Journal.*

The arrangement of the apparatus is shown in the accompanying illustration. A flow of water in the tunnel, *t,* is led through the cast-iron pipe, *a,* of 218 mm. diameter, to the air suction pipe, *b.* With the entrained air, the water then flows through the cast-iron pipe, *c,* 218 mm. diameter and 150 m. long, which is laid, somewhat crookedly, down an inclined shaft. The water discharges into the bottom of the receiver *d,* 1.1 m. diameter and 4.5 m. high, which rests upon an I-beam support in the shaft at a depth of 52 m. below the level of the overflow tunnel at *u.* The receiver is provided with a pressure gage, and a pipe, *g,* which passes up parallel to the discharge pipe and enters it at the discharge level.

The compressed air escapes through the valve, *e,* passing then into the reservoir, *i,* and thence, through the 80-mm. pipe, *h,* to the working places of the mine. The overflow water passes up through the pipe, *f,* 218 mm. diameter and 50 m. long, to the level *u.* The construction of the component parts of the apparatus is shown in the drawing. By the peculiar construction of the air inlet, which creates no compression of the water, and by the avoidance of sharp corners, the loss of head through resistance is reduced to a minimum.

The average flow of water through the system was found to be 3 cu. m. per min., which falling through the distance 99.3 m., between the intake and the discharge levels, yielded



CLAUSTHAL HYDRAULIC AIR COMPRESSOR.

3000 kg. x 99.3 m., ÷ 4500 kilogram-meters per min., or 66.2 h. p. In order to test the efficiency of the installation, at full capacity, a test was made during which the flow of water was measured by a weir, and the amount of compressed air was measured by the filling of a receiver of known capacity. It was found that 3.2 cu.m. of water per min., falling the 99.3 m., afforded 10 cu.m. of air per min., at an effective pressure of 5.1 atmospheres (90 lb. abs. per sq. in.). The work required to compress 1 cu.m. of air, adiabatically, to 5.1 effective atmospheres is approximately 24,300 kilogrammeters, so that, under the above conditions, the compressor was performing 10 × 24,300 ÷ 4500, or 54 h.p. The theoretical power of the water was 3200 × 99.3 ÷ 4500, or 70.5 h.p., showing an efficiency of 77 per cent.

The Pelton wheel had an efficiency of about 75 per cent., including in the computation the water, 4 or 5 liters, used for cooling the compressor, and the compressor had an efficiency of 85 per cent., so that the combined efficiency of the installation that was displaced by the hydraulic apparatus was only 64 per cent., as against 77 per cent. efficiency of the new installation. Assuming the same conditions as in the above mentioned test, the older combination of machines would have yielded only 0.64 x 70.5 x 4500 ÷ 24,300, or 8.3 cu.m. of air per minute.

The superiority of the hydraulic installation is seen not alone in the greater capacity and efficiency. In the following tables are compared the cost of compressing air by three different means, viz., (1) by a piston compressor, belt-driven from a water turbine consuming the same amount of power as the hydraulic plant. (2) By an electric-driven compressor of the same capacity and using the same amount of power as the hydraulic plant. (3) By the hydraulic installation itself.

1. *Water-driven Plant*

Investments:	
Belt-driven compressor	$1,250
Pelton wheel, complete	1,125
Building, foundations, etc.	450
	$2,825
Interest and Depreciation:	
Interest on plant at 5 per cent.	$ 141
Depreciation of machines at 10 per cent.	238
Depreciation of building at 3 per cent.	15
Operating expenses:	
Wages (night and day shifts)	600
Lubricants, ½ pound per hour	75
Repairs and waste	75
Total annual expense	$1,144

Assuming 6000 working hours per year, and an output of 7.8 cu.m. per min., the year's output by the above arrangement would cost $0.38 per 1000 cu. meters.

2. *Electric-driven Plant*—Assuming the efficiency of the compressor to be 0.90, of the belt or gear drive, 0.95; of the motor, 0.90; and of the current transformer, 0.950; the total efficiency of the electric-driven plant would be 73 per cent., and for the exertion of 54 h.p. would require the purchase of 74 h.p. from the central generating station.

Investments:	
Belt-driven compressor	$1,500
Electric motor, 70 h.p.	1,200
Buildings, foundations, etc.	450
	$3,150
Interest and depreciation:	
Interest on plant at 5 per cent.	$ 158
Depreciation of machines at 10 per cent.	315
Depreciation of building at 3 per cent.	15
Operating expenses:	
Wages (day and night shift)	600
Lubricants	95
Repairs and waste	100
Electric power, 74 h.p. for 6000 hr. at ½c. per h.p.-hr.	2,220
Total annual expense	$3,503

With an output of 10 cu. m. per min., the year's output by the above arrangement would cost $0.98 per 1000 cu. meters.

3. *Hydraulic Compressor*—

Investment:	
Compressor, installed	$3,750
Interest and depreciation:	
Interest at 5 per cent.	187
Depreciation at 5 per cent.	188
Operating expenses:	
Lost wages during shutdowns	30
Repairs	20
Total annual expense	$425

With an output of 10 cu.m. per min., the year's output by the hydraulic compressor cost only $0.12 per 1000 cu.m. It may be added that 10 cu.m. of air at 5.1 effective atmospheres is equivalent to 353 cu.ft. at a pressure of 90 lb. abs. per sq. inch.

RESPIRATION AND ATMOSPHERIC IMPURITIES

Mr. W. Thomson, before the Manchester and Salford Sanitary Association, recently described a series of experiments to ascertain the amount of carbonic acid in the air in Manchester (England), and in various buildings under different conditions. He was led to made these experiments by a request for some simple device for estimating the carbonic acid gas in public and other buildings. The method he recommended was that of forcing air into a bottle with an ordinary pair of bellows and submitting it to a simple chemical test.

FOUL AIR IN MANCHESTER BUILDINGS.

Mr. Thomson gave the results of the analyses of air taken in a number of schools in and near Manchester. For purposes of comparison, he took the amount of impurity that is accepted by modern architects as permissible in buildings—viz., six parts of carbon dioxide in 10,000. Samples of air taken in Macclesfield schools by Mr. Horsfall contained 1.4, 3.5, and 6.1 parts of carbon dioxide in 10,000. Air taken in some Manchester schools yielded proportions of carbonic acid gas as follows:—St. Matthew's, Deansgate (boys), 11.2; St. Stephen's, Hulme, 14.9 (girls) and 11.7 (boys); Crumpsall Lane School, 12.8 in one room and 8.3 in another; while in a school at Openshaw there was 18.2 in the boys' room and 11.5 in the girls'. In the Technical School there was 6.5. This building, Mr. Thomson said, was one of the best-ventilated in the city, but its atmosphere was objectionable to many people on account of its lack of invigorating qualities. He thought this was due to the method of washing the air.

In a Methodist Free Church near Manchester the air after service contained no fewer than 44 parts of carbonic acid gas per 10,000 volumes. Tests made in a large concert hall in Manchester showed 5.2 before a performance and 11.2 after one and a quarter hour. Tests in the Manchester Art Galleries gave 10.3 in one room and 8.6 in another. Three railway compartments yielded 12, 5.6, and 21.5. Air in a Manchester tram, 7.2. Old-fashioned houses with low ceilings in the country gave figures ranging between 5.6 and 12.5; new houses between 5.9 and 10.4, and a good sized room that had contained four persons and three gas jets for 1½ hour, 22. The carbonic acid gas in the air of one of the Manchester theatres before the performance was measured as 5.9, and after the performance, in the dress circle, 19.2.

HUMAN EXHALATIONS.

From these tests Mr. Thomson proceeded to find out the amount of carbonic acid gas exhaled in the breath of different people under different conditions. The amount of carbonic acid in the breath was given, he said, in books on physiology as about 4 or 5 per cent. The results of his experiments showed that the amount of carbon dioxide which a man breathed out depended upon the quality of the air by which he was surrounded. In Manchester he breathed about 4 per cent., and in the country 5 per cent., so that it would appear to be necessary to take about one-fourth more food in the country than was sufficient in town. The breaths of three men were tested. In Manchester the percentage of carbonic acid gas given off by each was—A 4, B 3.8, and C 4. At the Buxton golf links, 1,000 feet above sea level, the figures were 5, 5.2, and 5.2, and after they had played eighteen holes and had lunch they each gave 4.8 per cent. They then drove to the Cat and Fiddle, 1,700 feet above the sea and there A gave 5.2, B 5.4, and C 5.4. These results suggested that the amount of carbonic acid gas exhaled was influenced by altitude. But a test made at Blackpool did not sustain the theory. Further experiments showed that when a person went from Manchester to the country it had the effect of increasing the amount of carbonic acid exhaled to a percentage higher than that found in the case of people permanently residing in the country.

WHEN AIR IS HEATED.

He found, too, that when the air was inhaled through the mouth the breath was about .2 per cent. lower in carbon dioxide than when the nostrils alone were used. This was suggested to him that if the air were artificially heated a still greater oxidization would take

place in the body. Air heated to 140 centigrade was breathed, and the exhalation contained 5.4 per cent. of carbon dioxide, whereas exhalation of ordinary unheated air from the same person gave 4.4. The average in a number of experiments gave 4.1 from ordinary air and 5.1 from heated air. When pure oxygen was breathed the exhaled air gave an average of from 4.4 to 4.5, which was considerably below what one got from breathing in the country. It would appear, therefore, that country air was better for reviving people who had been asphyxiated or nearly drowned than pure oxygen, and that a maximum effect would be obtained from warmed country air and oxygen combined. It was found, however, that the hot air breathed in a Turkish bath had not the same effect as hot air breathed when the body was only at its normal heat.

DRY AND DAMP AIR.

Experiments were also made as to the effects of dry and damp air, and it was discovered that thoroughly dried air has a much more powerful oxidizing influence on the blood than air that has not been dried, and that this effect is increased by heating the air. This, Mr. Thomson suggested, was an important fact to consider when arranging the ventilation of buildings. Many people had noticed, he said, that the air of the House of Commons had a peculiarly flat taste. It was not invigorating, and the people who sat in the House suffered considerably from influenza. This was due to the fact the air forced into the House was washed in water.

CENTRAL COMPRESSED AIR SCHEME FOR SOUTH AFRICA

[The following we take from a recent issue of the South African Mining Journal. The general lack of economy in contemporary compressed air practice on the Rand and the large demand for power within a limited area there seem to afford unusual opportunity for the scheme here proposed to make a favorable showing. Further developments will be looked for with interest.]

Ever since central power stations were first mooted on the Rand far-seeing engineers have been debating the possibility of extending the principle of centralisation to our costly and admittedly inefficient compressed air plants. To-day we are in a position to announce that a scheme to establish central air stations, which has been two years in the making, is on a fair way to be definitely realized at an early date. With its power supply plans, the newest centralized electric power company proposes to include compressed air, the object being, of course, to relieve the mines from any and every necessity to generate either form of power for themselves by the comparatively extravagant and old-fashioned methods of to-day. What one power supply company can do no doubt the other companies can and will do also. Beyond the discussion of the matter, the other power supply people do not appear to have yet done anything in the matter.

To-day the resident engineer of the mine is largely responsible for the generation of the whole power supply. He is less anxious in regard to the total power consumed than he is in regard to the cost per unit of that power. The reason for this is simply that his figures under the latter head are capable of direct comparison with the average and other figures of the Rand; while no real comparison can possibly be drawn between the wastage, leakage and general loss of power on the various mines. For this reason, if no other, considerable economies are likely to attend the introduction of a purchased air power supply which can be measured exactly on each mine. The same argument applies with equal force in favour of purchased electric power.

THE NEW SCHEME.

The engineering features of the new scheme are full of interest. Naturally in several particulars the world-renowned Paris compressed air system will be followed in the design of the plant. In many respects, however, the Paris plant will be improved upon and advantage taken of the discoveries of modern practice and research. The Paris plant is driven by steam power. The Rand plant will be driven by electric power drawn from a central power station. The compressors will be of 5,000 h. p. capacity each, three-cylinder, two of low pressure, and one of high. Each compressor will have two 2,500 h. p. motors directly connected to its crank shaft. The motors will be coupled together, so that they can run at full or half speed without altering the number of the poles. Any variation in output of air required below these two variations of speed will be dealt with by means of inlet valves of the Corliss type,

operating by trip gear controlled from air pressures. In view of the experiments now in progress on the mines to determine the utility of high air pressures, the compressors will have a working pressure of from 80 to 110 lbs. per square inch, the pressure between these figures being dependant, of course, upon the requirements of the mines. The intention is to start with two chief stations on the Central Rand—one being situated in the Fordsburg neighbourhood; the other at a point half-way to Germiston. Later, as other areas develop, additional stations will be put down at central points. All these stations will be operated from a central electric power station. In the light of recent local investigations into the question of airpipe dimensions, it is noteworthy that the pipes to be used on the proposed scheme will vary from 28 inches down to 11 inches in diameter. Joints will naturally receive much attention. These will be electrically welded—no flanges; no threaded socket couplings; no expensive expansion joints. The air will be measured by meter at the mines, and the latter will pay by weight for the amount consumed—power actually used, of course, only being charged for.

ELECTRIC VS. AIR POWER TRANSMISSION.

To the layman, though not to the engineer, it will be news that it has been proved over and over again that it is cheaper to compress air direct at a central station and convey it by pipes to the various mines, than simply to supply electric power on the mines to drive the various compressors. In the latter case it has been found that the cost of plant is greater, and the losses in transformation heavier. At one time, it was considered more economical owing to saving in the outlay on pipes and the maintenance of a uniform pressure in the mine to transmit the air at very high pressure—200 lbs. and upwards—to receivers at a sub-station capable of storing energy for a large number of drills for an hour, and then to reduce the pressure by means of reducing valves before entering the service pipes to the mines to the usual working pressure. This method has been considered in the present case, but in the light of recent practice, rejected.

It is generally believed that electricity has a much superior advantage over compressed air for transmission purposes, that is, that there is a much smaller loss of energy over electric wires than through pipe lines. Compressed air has been badly misrepresented in this respect; this loss has been greatly exaggerated, and the catalogues of air-compressing machinery companies have not improved matters; in fact, they have done more harm than good as regards the interests of compressed air. The tables published in air compressor catalogues usually speak only of the loss of pressure; they fail to tell us that the loss of pressure is not necessarily, or to the same extent, a loss of power. As Frank Richards, in his work on "Compressed Air," says: "The actual truth is that there is very little loss of power through the transmission of compressed air in suitable pipes to a reasonable distance, and the reasonable distance is not a short one. With pipes of proper size and in good condition, air may be transmitted, say, ten miles, with a loss of pressure of less than one pound per mile. If the air were at 80 pounds gauge or 95 pounds absolute upon entering the pipe, and 70 pounds gauge or 85 pounds absolute at the other end, there would be a loss of little more than 10 per cent. in absolute pressure, but at the same time there would be an increase of volume of 11 per cent. to compensate for this loss of pressure, and the loss of available power would be less than 3 per cent. With higher pressures still more favorable results could be shown." As a competitor with electricity in long distance transmission, it seems almost like scientific heresy to claim for it equal if not greater efficiency; nevertheless it is claimed that within the 20-mile limit [10 mile radius? Ed. C. A.] compressed air will compare in efficiency with electric transmission, while so far as operating and maintenance expenses are concerned, the electric proposition is not to be compared for a moment with that of air. Over 15,000 h. p. of mechanically compressed air is distributed to-day throughout the city of Paris, being transmitted for a series of stations from three to fifteen miles distant, with a loss of 10 pounds pressure in transmission.

CHEAP ELECTRIC POWER.

An essential requisite of a successful central air-compressor scheme is cheap electric power. The guarantee of this in the case of the Rand assures the commercial success of the project. It also points to the fact that only those electric power companies that are in a position to supply electric power at an extremely low figure can engage in the sister-business of compressed air power supply. With compressed

air available along the Reef, it is possible that this agency may be used for many purposes in addition to driving rock-drills. The multiplicity of uses to which it is put in Paris, and the fact that it is a harmless medium of power transmission, when compared with electricity, makes it worth attention in this connection. The essential fact is that the new system will mean a great saving to the mines, directly and indirectly, better air pressures, more scope for resident engineers to study economy, and in the last resort, improved results for shareholders. And the promoters of the scheme can congratulate themselves on the fact that theirs is an idea which the best engineering brains of the Rand have pondered and recommended for many a long day.

COMPRESSED AIR FOR CLEANING GAS CONDUITS*

By W. D. Mount.

Three years ago, the writer had occasion to ask for proposals on a battery of gas producers, including the design of the distributing conduit and branches.

As the producers were to supply gas to furnaces in continuous operation over long periods, which, for efficient working, required very uniform conditions of heating, the question of an uninterrupted flow of gas of uniform quality became of exceptional importance. We found that all of the builders of producers could, in a general way, meet the conditions of uninterrupted service; that is, it would be necessary to shut the gas off a few hours once each week, and clean the accumulated soot out of the conduits.

Our idea of continuous service was somewhat different. It did not mean shutting down once a week, or once each month, but meant a condition of operation absolutely without interruption for an indefinite period, and we finally made this a condition of our acceptance of the contract.. The distributing conduits had to be designed to meet existing conditions of space and apparatus in a department already so much overcrowded that a duplicate system of conduits, one to be in use while the other was being cleaned, was entirely out of the question.

*Presented at the Detroit meeting (June, 1908), of the American Society of Mechanical Engineers. (Somewhat abridged.)

In placing the contract, our decision was not based altogether on the merits of the different producers offered, but largely on the method or system of cleaning, and a design of distributing conduits which seemed to provide the greatest facilities for meeting the imposed condition of uninterrupted service. After carefully canvassing the designs submitted, a contract was placed with the Morgan Construction Co., of Worcester, Mass., through their engineer, Mr. E. A. W. Jeffries, M. Am. Soc. M. E., who, to quote from one of his letters, was confident a method of cleaning the conduits, which, because of conditions imposed, was the most important function to be provided for adequately, could be worked out, but which required special study, and which involved some features not heretofore fully developed.

I may say, at this point, that the congested condition of the department in which the producer plant was to be installed, as well as the location of existing apparatus, precluded the possibility of using underground conduits, and made it necessary that an overhead system be adopted.

The plan of action arranged for, as outlined by Mr. Jeffries, consisted in providing facilities in the way of openings in the conduit for blowing depositions of soot through into the stack, by means of steam jets, connections to the base of the stack being arranged for from each distributing conduit. The above outlined operation was not to occupy more than 15 minutes, during which time the gas was to be shut off, but the heat in the furnace was not to be seriously impaired. The condition of uninterrupted service, it is to be noted, was not fully met, and the writer was confident at the time, and subsequent developments proved his prediction to be correct, that when the gas was shut off, even though as small an amount of time as 15 minutes, it meant shutting off the product from the furnaces, or, in other words, it meant an absolute shut down of the department during the operation of cleaning.

The producers and distributing conduits, however, were installed as designed, and the proposed method of cleaning put into effect, with the exception that compressed air was used in place of steam. Measured by experience gained, the method was a great success, but as a means of keeping the gas conduits clean, it was a failure.

It did not take long, however, to determine that the idea was all right, and that our lack of success was due to the fact that the facilities provided in the design for applying the air or steam were inadequate, as well as improperly located.

The experience gained in the early days led finally to the development of the system to its present form, which is fully detailed in the accompanying sketches, and which I am glad to report, has been so successful that for the past 18 months we have never for a moment had the gas shut off from our distributing conduits for the purpose of cleaning out the depositions of soot. The method and apparatus, as will be noted from the drawings, are extremely simple, and quite out of proportion to the results obtained.

COMPRESSED AIR A NECESSITY.

We have so much confidence in compressed air that we are almost inclined to believe that it is one of the things essential to the successful operation of the method, another being accessibility to the main conduit and its branches. The air should be thoroughly dry and at not less than 80 lbs. pressure. We find in practice that the connections from the conduit to the base of the stack are, for cleaning purposes at least, entirely unnecessary. The only time they are used is in making repairs on the conduits, when they are opened for the purpose of drafting out the gas. We also find that about 75 per cent. of the soot is deposited in the drop legs immediately behind the producers, the balance being dislodged by means of the air jet from the brick lining and carried along with the current of gas to the furnaces where it is almost wholly consumed.

Referring to Fig. 1. A A are openings in specially designed castings (see detail A, Fig. 2) spaced along the top of the conduit, and of the same depth as the brick lining. C is a cast-iron ball of a diameter sufficient to close the opening in A and free to slide on the ½-in. bent pipe B (see detail of C) which is connected by hose to the air main, a 1-in. pipe serving also as one of the hand rails along the top of the conduit.

The openings A A are spaced at a distance nearly equal to the diameter of the conduit (although this spacing is not necessarily fixed), which we have found by experience to be about right for effective work, and in any event they should not be at a distance exceeding 6 ft.

The bent pipe B should be long enough to reach all parts of the conduit from A to A. The pipe, however, for convenience in handling cannot be over 8 ft., and its length, therefore, in a measure, fixes the distance from A to A. Permanently attached to the end of the

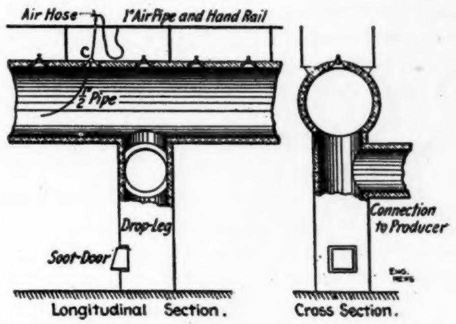


Fig. 1. Main Gas Conduit Arranged for Cleaning While in Operation.

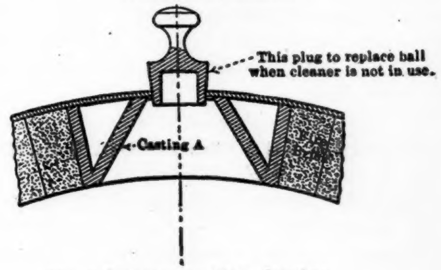


Fig. 2. Cleaning Hole Casting.

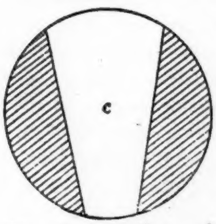


Fig. 3. Section of Swivel Ball for Air Pipe.

CLEANING GAS CONDUITS.

pipe is a short length of air hose, having attached at the other end the male portion of a standard ½-in. Joy coupling. Located along the hand rail air pipe, at distances from two to three times the distance between A A, are cocks and the female portion of the Joy coupling. Attaching the hose to the air main, therefore, is a very simple matter and consumes a minimum of time.

In cleaning we begin at the producers and work toward the furnaces. To the casual observer it would seem that the operator did nothing more than stick the bent pipe through the opening A and turn on the air. This, however, is, of course, the most insignificant part of the operation. It is necessary that the pipe be given a circular motion, which will bring its discharge end in contact with all parts of the brick lining from one opening to another. A careful, conscientious workman will, in a little time, become very expert in the operation, and when the work is properly done it can be absolutely depended upon to remove all depositions of soot.

In conclusion, it is only necessary to say that th gas is not shut out of the conduit during the operation of cleaning, nor is its flow in any way checked. The producers do not seem to be affected in the slightest degree; in fact cleaning is conducted absolutely without interruption to producers, conduits and furnaces, and that it is efficient is evidenced by the fact that when our conduits have been opened for repairs we have always found them clean to the brick lining.

AUTOMATIC AND CONTINUOUS SAND BLASTING

The following we condense from a recent issue of *The Foundry*.

Fig. 1 shows an automatic, continuous sand blasting arrangement designed for the cleaning of large quantities of small castings. There is a steel plate conveyor which carries the castings beneath the sweeping blast from a series of suspended nozzles which have a rocking motion with suitable arrangements for disposing of the castings and the sand. The apparatus can of course be driven from any available source of power. Also, as the entire apparatus is encased and an exhaust fan provided at the rear, it can be operated without discomfort in the foundry itself.

TRAVERSING THE BLAST.

A primary and important feature is the moving of the blast jets back and forth, a principle adopted in a tumbling barrel designed by Mr. Drucklieb, 42 Reade street, New York, whose ideas are also embodied in the present apparatus. The reciprocating movement of the nozzles secures uniform treatment for all the castings which pass under them.

In the apparatus here spoken of a number of nozzles—dependent upon the width of the machine and the rapidity of treatment desired—are fitted to an iron pipe, which is suspended above the conveyor. These nozzles at their tips are about 6 inches from the surface of the plate; they are inclined slightly toward the rear, as the resulting deflection of the blast by the plate facilitates the cleaning of the under side of the casting as well as the top. This iron pipe is closed at one end and connects at the other with a rubber hose running to the sand blast apparatus. On the closed end the pipe is merely hinged to a support built up from the body of the device, but at the other there is provided a bell crank, to which a reciprocating motion is imparted by a disc crank on a hanger above, or by a motor located on the top of the housing.

THE CONVEYOR.

The castings are shoveled onto the conveyor at the front and travel through the machine at any desired speed, 8 or 10 feet a minute being the usual rate, as this affords ample time for the sweeping motion of the blast to cover every section of the plate. After passing under the blast, the castings fall onto an inclined steel plate, through the perforations in which the sand falls into a lower bin from which it can be taken for later use. An upper sand bin is located just beneath the path of the conveyor plate on its return trip and catches whatever sand does not fall to the lower bin. The castings chute leads either to a suitable box beneath the machine or to a table for inspection.

For the most part it will be found that one trip under the sand blast is sufficient to clean the casting on both sides. Where extremely uniform results are required, however, it is necessary to return some few of the castings to the conveyor for further treatment of the under side. It is the usual practice abroad, where automatic cleaning devices are employed, to return practically all castings for a second treatment, one common arrangement being to place them on a table revolving beneath a blast and station a workman at one side to turn all passing before him that require it and to put on and remove the castings as needed to maintain continuous operation.

The chamber in which the cleaning is done is almost entirely encased, the opening in he front being high enough only to admit the load of castings on the conveyor. The direction of

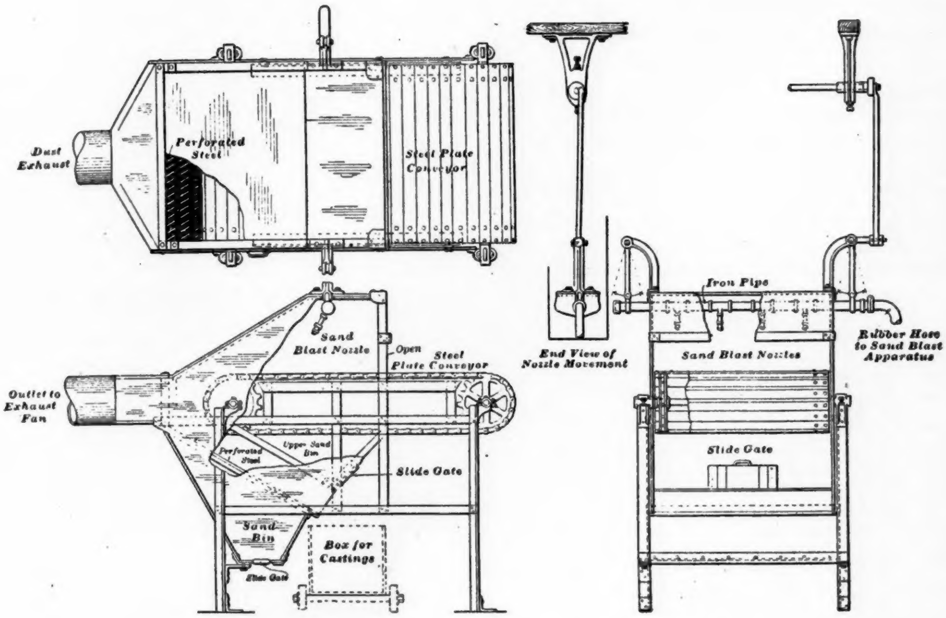


FIG I, PLAN, SECTIONAL AND FRONT VIEWS OF AUTOMATIC SAND BLAST DEVICE.

the blast is toward the rear and this, with the draft of the exhaust fan, carries off the dust and dirt commonly encountered in sand blast practice, rendering the operator free from danger and discomfort.

CLEANING LARGE CASTINGS.

Where a considerable number of large castings of similar type are to be cleaned, an arrangement of sand blast equipment, also designed and built by C. Drucklieb, offers some remarkable advantages in ease and speed of handling and in economy of floor space, all factors of importance in the brisk competition of present day foundry operations. In the installation shown in Figs. 2 and 3, which has been in use for some time with signal success in several forms, heavy car coupler castings are treated.

In the corner of the foundry, not far from the heating furnace, is located a battery of three hooded sand blasts, so arranged that a single trolley line, with proper switching facilities, serves them all without confusion or delay. As they come from the furnace the castings are transferred to the cooling floor, where they remain until they lose their color and are sufficiently cool for sand blast work. One of the castings is then picked up by tongs attached to a trolley and swung around to one of the blasts, entering through an opening in the side and a slit in the roof of the case. The front is open, and through this the operator applies the blast, operating a nozzle by hand. The casting hangs on a swivel and when the front is treated it is swung partly around with a hook and the other sides are

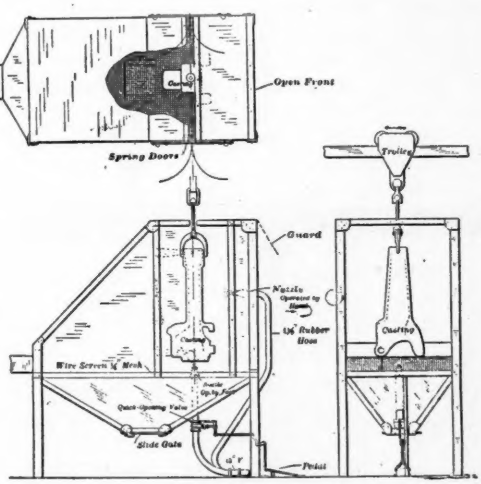


FIG II, SAND BLASTING LARGE CASTINGS.

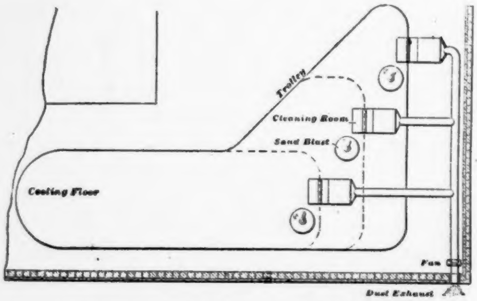


FIG III, THREE SAND BLAST MACHINES.

cleaned. After the outside treatment is completed the hollow center is cleaned by a blast from beneath, the valve of which is operated by a pedal.

Just below the lower level of the casting a wire screen of ¼ inch mesh is provided to catch the heavier particles blown off, the sand dropping through into a bin equipped with a slide gate. The front of the device is open, except for a small guard for the operator's eyes at the top, but the three hoods connect at the back with an exhaust fan system, and all dust is taken care of in this manner. The process is continuous, the castings swinging through the cleaners and passing to the storage and inspection floor in a complete circuit without any reversal of direction.

THE NIAGARA SAND BLAST

The Niagara sand blast must commend itself first of all by its simplicity. Fig. 1 shows the entire apparatus. It cleans castings fresh from the mold, or just as readily removes scale, rust or paint from metal of any kind and it uses the common shop air pressure of 80

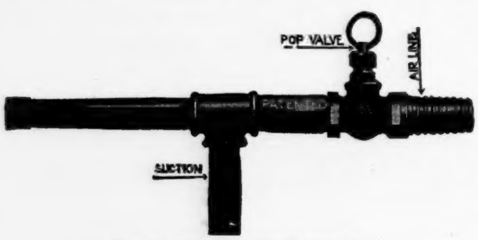


FIG I, NIAGARA SAND BLAST.

to 90 lbs. The device speaks for itself as to simplicity and as here shown it weighs but 5 lbs.

No sand tank is required. Sand sifted through a screen having an 1-8 inch mesh is used; the coarser the sand the better. It is siphoned direct from the ground, or from a pit, pail or barrel, and the sand once used needs only to be sifted to be used over and over. The ends are fitted for 1¼ inch hose. The suction should not be over five feet long, and it should be weighted at the end to hold it steadily in position. Should a stoppage occur from any cause the passages are instantly cleared by pressing the nozzle against a firm surface and then turning on the air pressure. The air is thus backed up through the sand hose, removing whatever may be lodged there.

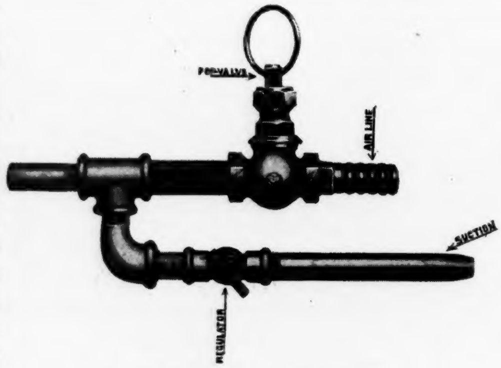


FIG II, NIAGARA PAINTER.

The Niagara Painter, Fig. 2, is the same as the sand blast in its principle of operation. For this a ½-inch suction hose is used and this also should be not over five feet long. Should the pop valve be too loose it should be packed to suit. To back the air into the receptacle holding the paint for the purpose of stirring it up, all that is necessary is to place the hand over the discharge nozzle at the same time opening the pop valve. This operation may also be employed for cleaning the tool if the suction hose is removed from the paint pail. These devices are manufactured by the Niagara Device Company, Buffalo, N. Y.

THE "STEAM" SHOVEL IN ZINC MINING

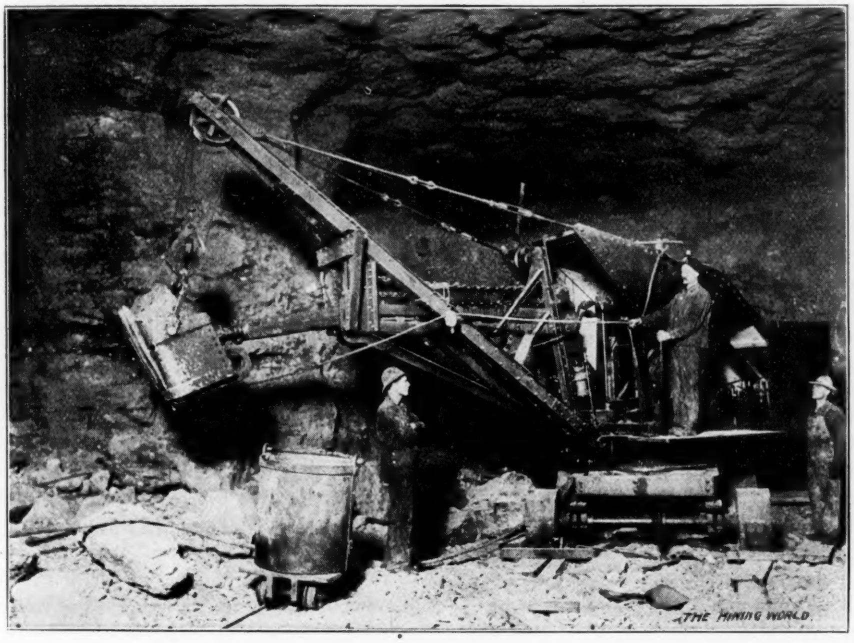
The Steam Hammer will probably never be known by any other name, although a large and rapidly increasing number of such hammers are now being operated by compressed air. The steam dredge also has its name fixed for life, but we show here a "steam" dredge which is driven by compressed air. The half-tone and the description following, by Otto Ruhl, we reproduce from *The Mining World.*

The first steam shovel ever used in zinc mining has been introduced into the Missouri-Kansas district by the American Zinc, Lead and Smelting Co. in its mines at Prosperity. This shovel is being utilized in the No. 2 shaft at a depth of 200 ft. from the surface, in a drift 15 ft. high. The shovel has now been in use about four months and has been tried out very carefully.

The machine was designed by Capt. R. Thew of Loraine, Ohio, who spent some time in the mines of the American Zinc, Lead and Smelting Co. studying the conditions to be met in the construction of the steam shovel. The machine is much like the ordinary steam shovel, the crane being 18 ft. long and constructed of steel.

At the extreme end of the crane the steel cable attached to the shovel for lifting, runs over a pulley down the length of the crane to a revolving drum actuated by an engine which is under the control of the operator. As a part of the crane there is a second arm which works upon a slide bearing and hinges in it at one end. Upon the other end of the arm is fastened the shovel proper. This arm is actuated by a chain belt which will shove it outward into the ore, or pull it backward. The crane is attached to the platform of the machine at its base, and is supported from its outer end by heavy truss rods.

Upon the platform there are three engines, one of which drives the drum which elevates the shovel at the end of the crane, a second which pushes the arm that holds the shovel, while the third engine revolves the platform so that the shovel may be worked in any direction. Each engine is run by compressed air.



AIR OPERATED STEAM SHOVEL IN A ZINC MINE.

All the machinery is shut in by thick heavy steel plates, which act as an armor, thus protecting the delicate working parts from flying rocks when any blasting is done. The levers for the control of the three engines are at one side of the machine so that one operator may have full control of the shovel. All the machinery is rigidly fixed upon a revolving platform, which is built very strong and heavy, and is supported by heavy trucks to hold the immense load, amounting to several tons. The machine can be moved from drift to drift by its own traction, one engine being used for this purpose. It is not moved on tracks, but heavy boards, which are placed under the wide tired wheels to furnish a smooth surface.

The machine is built entirely of steel, and will wear a long time. The dipper of the

shovel has a locking bottom, and the operator dumps by pulling a rope. When the shovel is again lowered the bottom is self-adjusting. A set of strong steel teeth are attached to the mouth of the dipper to aid in gathering up boulders. These can be easily replaced at slight expense and prevent the dipper from hard wear.

The machine has not been in operation long enough to fully test its capacity, though it has handled from 200 to 300 cans of material, holding 1,200 to 1,500 lbs. This is equivalent to 250 to 450 cans of the ordinary 1,000-lb. size. Each shovel takes up from 600 to 700 lbs. of ore, and two shovelfuls are required to fill a can. One advantage in this system is that there are no "windies" (cans only partly filled), every can being filled entirely, which adds to the efficiency of operation.

The cost of operating this machine is about equal to 30 hp. for power, or sufficient air to run two machine drills. Two men are required to operate the machine, one to handle the shovel and one to break boulders and get the dirt in position to be taken up. A large amount of dirt can thus be handled, providing too much time is not lost in moving the machine from drift to drift, which is quite an undertaking. If the machine is kept close to a large number of drifts the work will be continuous and can be accomplished at low cost.

The steam shovel cannot be operated in every mine, as certain conditions have to be met. The minimum height of roof is 14 ft., and work in a lower drift would be impossible, unless the machine were remodeled and the present form greatly changed. Thus, only a few sheet-ground mines could operate the shovel, as most of them have roofs from 7 to 9 ft. high. Another limitation is that the machine could not be operated where pillars are placed close together, as a swing of 25 to 35 ft. is necessary. Thus, in soft ground where there are many timbers the shovel could not be used at all.

The highest head power plant in the world has been designed for a Norwegian factory. The total head is 3,287 feet, the water being taken through a seven-mile tunnel from a lake 3,536 feet above sea level to supply six turbines of from 12,200 to 14,600 horsepower each, with direct connected generators.

AIR-DRILLS AND THEIR EFFICIENCY

By Samuel K. Patterson.

Probably no branch of engineering development is on a par to-day with that of air-drill operation from the standpoint of inadequate efficiency. The introduction of the air-drill in mining and as an industrial factor for other purposes was a great step in advance and represented considerable progress in engineering development, but since that time air-drills themselves have made little or no progress in efficiency. Many of the ordinary facts or physical data essential for their operation are practically unknown, and this is due as much to the lack of adequate methods for their determination as to any other reason. Thus, even the question of what is meant by efficiency of an air-drill is debatable ground. The average manufacturer will say that it depends upon the initial air-pressure, air-consumption, and rate of drilling, but that no adequate or scientific conception of the same is possible or at hand. It is a generally accepted theory that air-drills in actual operation work best with an air pressure of 80 to 100 lb. Some extend this to 150 lb. initial pressure. The air-consumption varies with the size of the drill, but for the average drill it is approximately 100 to 150 cu. ft. of free air per minute, compressed to 80 or 100 lb., taking the full supply available from an average 8 by 8-in. compressor. Until recently the speed of such drills, or the number of blows per minute, was variable and practically unknown, and the foot-pounds of the blow has been determined in rare instances only. No indicator diagram of the action in the cylinder has ever been made or is obtainable with the ordinary indicator on account of the inadequacy of this mechanism for such speeds, and because of the high corrective factor due to inertia and to the velocity of its parts. The action of the valves, and the effect of the port in reducing the air-pressure, are largely a matter of conjecture.

All drills for mining purposes can be divided essentially into two classes, those in which the valves operate by mechanical means imparted by the motion of the piston itself, and those operated by a differential air-pressure produced in various ways. The position of the valve is apparently determined largely by question of convenience in design from an operative and constructive viewpoint, rather than

from the view of efficiency or air-consumption. The Ingersoll-Rand pneumatic hammers and drills have a valve operating by differential air-pressure at right angles to the motion of the piston, and installed in the handle of the device or at one end of the piston-cylinder. This necessitates comparatively long ports for the action of the hammer or drill during a portion of its stroke. The Rex pneumatic air-drill possesses a mechanically operated valve installed in a cylinder parallel to that of the piston proper, and possesses much wider ports and equally distributed passages. The McKiernan drill possesses features of both types, with a side valve-chamber operated by differential air-pressure. Other types are more or less similar, and the data herein given refer more especially to the average drill used in mining. Air-driven hammers, saws, augers, riveting machines, and a number of other devices, fall equally in this category, but their range is so wide, and their variability so great, that they have not been considered. However, all the conditions which hold in this particular type hold equally well in regard to the majority of air-driven tools where the frequency of the device operated is of such a character as to preclude the utilization of the ordinary appliances in their measurement.

The ordinary steam indicators as used in the indication of steam units, pumping machinery, ammonia and air-compressors, are inadequate as instruments of precision in this particular field. In fact, no satisfactory indicator for high-speed gas-engines is as yet available. Equal conditions hold in regard to high speed steam engines, especially those direct-connected to electric generating units, and the necessity for a satisfactory indicating device where the problems of inertia and rigidity have been satisfactorily met for these speeds will undoubtedly prove as great a boon in the utilization of compressed-air as in the production of power by any kind of the high-speed engines. In regard to the action of compressed air in an air-drill it is assumed to be somewhat similar to that of steam in reciprocating-pump machinery. No cut-off exists in either type, and the pressure is supposed to be maintained more or less constant throughout the stroke. However, the use of indicators or pressure-gauges direct-connected to the cylinder of air-drills registers a fall in pressure of from 20 to 40 per cent. over that existing in the hose and valve-chamber, and whether this is due to inadequate size of ports or is in reality a measure of the average or mean effective-pressure is unknown. Only recently has this drop in pressure in the air-cylinder of the drill become generally known, and a more thorough study of the phenomenon is being undertaken.

Again it has been the generally accepted dictum among air-drill operators and superintendents that air-drills operate at a maximum efficiency of from 80 to 150 lb. air-pressure. That such drills should operate more efficiently at higher pressures is a reasonable conclusion if faults of design do not enter. It is also reasonable to assume, within certain limits, that a given drill should possess a maximum efficiency at a given initial air-pressure, due equally to details of design and operation. However, the statement that all air-drills are limited in their maximum efficiency, independent of design, to certain values in initial air-pressure is, if correct, undoubtedly due to faults in the design and operation of such types. The use of differential air-pressure in the operation of the valve, with this differential air-pressure obtained by allowing the direct ejection of a portion of the air into the atmosphere through an intermediate air-chamber at one end of the valve-piston, is not only an extremely wasteful device for the operation of the piston, but is an unnecessary one as well. It has also been the generally accepted conception of engineers that all drills other than compressed-air drills have been tried and proved unsatisfactory. While undoubtedly this may be true under present conditions, that it is a necessary condition is by no means a foregone conclusion.

The type of drill in which the air is compressed by electrical means in the immediate vicinity of the drill cylinder, to be used at once, represents a possible development along lines possessing considerable advantages.

[This allusion to the Electric Air Drill is misleading. It is in a class by itself and not comparable as to mode of operation with drills as ordinarily driven by compressed air. Its constituent compressor, so called, is more correctly a pulsator, and its reduction of pressure upon one stroke is a function as essential as its compression upon the other stroke. Ed. C. A.]

The condition of affairs may be summed up in the statement that our knowledge of operat-

ing conditions in the utilization of compressed air in the average air drill, and in other air drills, is essentially inadequate, and more complete information is highly desirable.

* * * * * * * * *

COMMERCIAL EFFICIENCY.

Mechanical efficiency, however, is in reality a matter of minor significance in the operation of air drills in comparison with that involved in a consideration of the factors affecting the commercial efficiency. Thus, the labor cost and other items are such in the operation of air drills that the efficiency of a drill is measured in reality by the time of boring, and is practically independent of air consumption in the choice of a type. The drill which has a small percentage increase in the rate of digging can in reality consume several times the quantity of air in its operation and still be more efficient, on the commercial side, than the more efficient mechanical type in the actual operation of the drill itself.—*Mining and Scientific Press*, San Francisco.

THAWING EXPLOSIVES

The following is noted from a paper by Mr. P. N. Denison, read at the Toledo convention of the Ohio State Stone Club:

During the year ending June 30, 1906, we find the item "thawing dynamite" second in the list of accidents occurring in the use of explosives. Sixty-six accidents due to thawing, with thirty-two fatalities, and I venture to say nine-tenths of them could have been prevented had proper care been exercised in the thawing.

The following table from the British Government report covers all accidents from thawing from the year 1872 to December 31, 1905. Every method mentioned is contrary to law in England:

1 Heating over fire	38
2 Reheating water in which dynamite had been previously placed to thaw	11
3 Placing the explosives in water, then heating that over a fire	10
4 Placing the dynamite cartridges in ovens	8
5 Thawing cartridges in the hands over a lighted lamp or candle	7
6 Placing dynamite in hot ashes	7
7 Warming on a shovel over a fire	5
8 Placing cartridges on top of heated stone	5
9 On a hot iron	4
10 On a steam pipe	2
11 Rubbing cartridges together to warm them by friction	1

Our record shows nearly as many accidents in twelve months as England had in thirty-four years.

Frozen dynamite is a dangerous article to handle. The nitro-glycerin is crystallized. Opening the end of a cartridge, you see the bright little specks that look like mica, and these crystals are sensitive to friction.

In the United States from July 1, 1905, to June 30, 1906, five accidents were reported from "breaking cartridges in two." A man was killed at Bellevue, Del., by breaking a frozen cartridge of 60 per cent. N. G. powder in his hands. This practice is prohibited by law in Austria.

A blaster in this State was killed by tamping improperly thawed gelatin dynamite with a wooden bar. He was tamping the first couple of sticks when it exploded and blew the tamping bar through his body.

At Mitchell, Ind., last winter a man was killed when attempting to open a box of frozen dynamite with an ax or pick. Ordinarily, however, frozen dynamite is hard to detonate; in no case do you get its full strength, and when but chilled a great per cent. of its strength is lost. Therefore it is necessary to thaw this explosive, and now we come to the actual work in preparing for a shot in cold weather.

Don't thaw the cartridge in hot water. I find this a common but very poor practice. It injures the explosive power by killing the effect which should be had from the soda ingredient, the paraffine coating is washed away, and, N. G. being heavier than water, there is always the chances for a remaining puddle of "soup," as the safe experts call it, to cause an accident. Also the water-soaked cartridges present an easier target for Jack Frost than those thawed in a dry atmosphere.

To thaw by throwing live steam against dynamite presents nearly the same problem as that of hot water.

Don't thaw over live steam pipes, on hot iron, around an open fire or on the boiler. The last named "don't" claimed a victim last

winter at a Kalida, Ohio, quarry. Dynamite thawing on top of the boiler exploded and killed the engineer.

For thawing large quantities of dynamite, a thaw-house heated by hot water pipes, the radiators being at the back or sides of the building and protected by a wooden partition, is by far the safest method. If it is arranged that the cartridges may be laid out on grooved shelves, each stick by itself, so much the better, for each will then obtain a uniform and regular heat and insure best results.

For small quantities there are several safe methods of thawing, just as easy and no more expensive than some of the dangerous methods now in vogue, and I cannot see why they are not generally used.

For instance, a man will take a bucket, fill it with dynamite cartridges and pour hot water over them. When they are good and slushy he takes this mush out, pours it in the drill-holes, gets a bad shot, and either jumps all over the dynamite, or explains it by saying his stone is changing and the bottom is harder to shoot. Why can't he take the bucket filled with dynamite, then loosen up and buy a larger bucket to hold the water? Place the smaller bucket within the larger and cover with rags or anything to hold the heat. There you have a perfectly safe thawer, your dynamite is in the best of shape, and you save much of its explosive force. It can be carried to the shot and loaded direct, thereby minimizing the chances of being chilled.

There are thaw-kettles on the market, built on much the same plan, which can be purchased from any explosive manufacturer.

For somewhat larger quantities, use a barrel for the hot water and a milk can for the dynamite.

Manure makes a good thawer where the quarry is so situated that a supply can be kept up. The thawing-house should be covered to a depth of two feet which will generate a good heat. Authorities differ on the length of time manure will hold its heat-giving qualities. Some say two or three weeks, while others claim the same manure covering will give out heat all winter long. The contractors on the New York subway work used this method generally, burying a box sufficient to hold three or four cases of dynamite, in manure, then dug it out when needed. Opinion there seemed to give manure a life of two or three weeks only.

If thawing-kettles are used it is best to carry them direct to the shot. In large quantities where you have a stationary thawing-house, protect the dynamite on the way to the shot by, say, a burlap covering, or provide a box wherein it may be placed and covered up when hauled to the blast. In other words, once thawed, keep your dynamite from all possible chance of exposure and get your shot off as quickly as loaded.

The most practical explosive for use in this particular territory, principally of limestone quarries, is the low-freezing grades of dynamite. This calls for no special detonators or extra trouble, and is, without doubt, one of the best things on the explosive market today. In strength it corresponds to the well-known grades of Hercules dynamite.

It will not freeze until the thermometer reaches 30 degrees Fahrenheit, two degrees below water-freezing point. That is the resistance to cold weather claimed at present; it will not freeze above 30 degrees Fahrenheit, but I have records where this powder was used in weather much below 30 degrees, and it was not frozen.

MOTOR-DRIVEN COMPRESSORS FOR ROCK DRILLS

A visit to towns in the Lake Superior region recently, where rock drills are in abundance not only for quarrying, but for grading of streets, etc., showed that motor-driven air compressors for supplying these pneumatic rock drills are displacing steam plants. Electricity can usually be supplied by central stations for this purpose at a rate which will make it uneconomical to operate a steam plant. In the cases where the steam direct from the boiler is supplied to operate the rock drills, the trouble from freezing in the winter and the trouble with steam hose make the motor-driven compressor desirable. Mr. William Chandler, in a discussion at the Michigan Electric Association in August, spoke of a 225-h.p. motor driving a compressor supplying rock drills at Sault Ste. Marie. This compressor plant made a saving of $7,000 in first cost over that of the former steam plant, which would otherwise have been erected by the contractor.—*Electrical World.*

SENTIMENTAL SCIENCE

The following neat presentation of the essentials of the Goldschmidt Thermit process is translated from the German of Haus Dominik and appears in the latest issue of *Reactions.*

Once upon a time there lived an Aluminum scraplet—a neat and pretty grain of metal. It had a deep and almost invincible passion for an oxygen atom. In the realm of nature there are not so many conventions to be observed as among mankind and thus it came about that soon after the creation of the world our Aluminumlet could seek out its love and enter into intimate and permanent union with oxygen. Like many other happy marriages, however, the glamour of pre-wedding days did not continue right along, as the union resolved itself into common gray clay.

For thousands of years the clay marriage led an uneventful existence, until man interfered in their relations. Then, of course, there was an end to peace and quiet. What time, cold and heat had failed to do, was achieved by the electric current. It tore asunder the closely united. Bright Aluminum remained in the electric furnace, dissolved in incandescent separation pains, while the divorced oxygen escaped into the open.

Now, we cannot conceal, much as we regret it, that oxygen's conduct was not free from reproach. While Aluminum, even after the separation, continued faithful, oxygen went in search of other attractions. Its liking for the sparkling and glistening was undeniable and whenever it saw something bright, it wanted to go and make up to it. As Aluminum had been torn away, it sought and found consolation and distraction with iron. The two formed a new union, which was registered in the chemical register as Peroxide of Iron. In daily life it was called Rust for short.

You must not blame Oxygen too much for its faithlessness—it cannot help its extraordinarily versatile and fiery temperament. Besides, even in its new union, it by no means felt entirely happy. Although its connection with iron gave it temporarily a prominent position in the world, in its heart the old liking for Aluminum still lIved with unabated vigor, the force of which electrochemists give as 3455 Thermal units per kilogram. The Rust menage continued not exactly unhappily, but still not happy, while bright Aluminum sorrowed in loneliness.

That state of affairs awakened the compassion of Dr. H. Goldschmidt, of Essen, and he resolved to end this misery. In order first of all to offer an opportunity of mutual approach to the separated ones, he mixed together the Aluminum particle and the iron rust. That did not help much at first. He knew the right spark to rekindle the affinity of the oxygen for Aluminum, however. Then happened what in old tragedies is called the reward of love and faithfulness, while Chemistry dubs it a thermochemical reaction. The union Rust broke up. With a sudden rush, oxygen tore away from iron and fell into Aluminum's arms, reuniting once more into the old clay. So strong was the impact and so tremendous the exuberance of feelings, that in a moment the whole concern scintilated in a refulgent glow. In the vessel where these things happened, there lay at the bottom superheated liquid iron and at the top liquid clay at a temperature of 5400°F.

BAROMETRIC CONDITIONS AND THE FREEZING OF WELLS

It is a rather curious fact that shallow, open wells give less trouble from freezing up in winter than the deeper drilled or double tubed driven wells, where the inner or pump tube is carried below the outer casing. The following notes by the United States Geological Survey throw light on the matter:

The freezing of wells is practically confined to districts where the air temperatures frequently go considerably below zero, and where the materials penetrated are either porous or contain actual openings and passages through which the air can circulate. A study of the phenomena as a whole shows that they are closely connected with barometric changes. The direct cause of the freezing seems to be an indrift of cold air at periods of high barometer. Change of weather, reversing the direction of the air current, produces thaw. In open wells, where air obtains access through the soil and at the junction of curb and cover, a cement cover should be tightly fitted to the curb, and the curb itself should be coated with cement for some distance below the surface. In drilled or double-tubed driven wells the current of cold air drawn in at periods of high barometer between the outer and inner casing near the surface and passing out in a porous bed at the bottom above the water level will cause freezing if the water is pumped so that

it stands in the inner tube above the lower end of the outer casing; and a long-continued current of such cold air may cause freezing of the ground water about and in the well tube. For this condition it is suggested that the space between the outer and inner tube near the surface be packed with some impervious material. A filling of cement resting on an improvised plug is probably the most effective. The home-made rag packing sometimes used is too porous to serve the purpose. The same treatment is suggested for wells with leaky casings, for driven wells passing through rocks porous enough to permit the passage of large currents of chilled air during periods of high barometer, and for wells in which the outer casing ends in some cavern or open passage; that is, the space between the well tube and the pump tube near the surface should be tightly plugged with impervious material.

AIR LIQUEFYING TESTS

The accompanying table, from Bulletin 21 of the University of Illinois, gives the results of recent tests in connection with an air liquefying plant at that institution. The tests were made in the mechanical engineering laboratory to determine (*a*) the most economical conditions for operating the liquid air plant belonging to the department; (*b*) the power consumed and cost of production of liquid air in plants of this type; (*c*) the efficiencies of the separate units composing the plant, and (*d*) the keeping qualities of liquid air in the Dewar bulbs of different sizes, mirrored and unmirrored, enclosed in felt receptacles and open without covering of any kind.

A description of the four-stage high pressure air compressor and of the liquefier, which is of the Hampson laboratory type, is given with details of the methods of measurements, etc. In regard to the temperature of the air entering the liquefier, it is remarked: "We have measured the influence of temperature over a range between 0 degree and 20 degrees C. for two pressures, namely 2,000 and 3,000 pounds per square inch, and the data are given under tests 1 to 7 inclusive. If the inlet temperature were below zero the efficiency would be correspondingly greater and the cost of production less; but it does not seem advisable in intermittent operation of the plant to reduce the temperature of the entering air below zero, as the trouble and labor necessary to keep a freezing mixture of salt and ice in the precooler more than balance the gain in efficiency."

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
No	Receiver Pressure lb. per sq. in.	Ten. Entering °C.	Temp. Air Leaving Liq. °C.	Room Temp. °C.	Motor Speed r. p. m.	Compressor Speed r. p. m.	Grams of Air Liquefied per hr.	Total Wt. of Air Delivered per hr. grams	Percent of Air Liquefied	Delivered horse power	Grams per d. h. p. hour	Pints Liquefied per hour	Cost of Power per Pint dollars	Total Cost per Pint dollars	Per cent d. h. p. Available in Liquid Air
1	2000	11	9	18	938	178	1555	33700	4.6	15.40	101.0	3.53	0.298	0.39	1.5
2	2000	19	17	16	918	173	1362	32800	4.2	15.20	89.6	3.09	0.324	0.44	1.3
3	3088	20	18	24	1130	210	2960	39600	7.5	19.74	151.0	6.77	0.192	0.24	2.3
4	3110	10	9	16	1130	211	3165	39800	8.0	19.50	162.0	7.18	0.178	0.23	2.4
5	3140	4	4	19	1129	209	3170	39400	8.0	20.0	158.5	7.20	0.183	0.23	2.4
6	3137	0	5	19	1131	210	3282	39800	8.3	20.2	164.0	7.46	0.178	0.22	2.5
7	2128	0	4	21	1157	210	2485	39800	6.3	18.2	137.0	5.67	0.213	0.27	2.1
8	1116	-2.5	4	21	1156	214	560	40200	1.3	13.8	39.8	1.25	0.728	1.01	0.6

TABLE OF AIR LIQUEFYING TESTS.

The loss of energy in producing liquid air is shown in column 16 of the table. Under the most favorable conditions, it is added, the available energy of the liquid air is only two and one-half per cent. of that expended in producing liquefaction.

The cost of production is given in columns 14 and 15 in the table. The only expenses included, it is stated, are cost of power used, estimated at eight cents per kilowatt hour, and cost of one attendant at thirty-five cents per hour. When running at 3,000 pounds pressure the cost of the liquid air obtained is given as twenty-two cents per pint. When running at 2,500 pounds pressure with air entering liquefier at 15° C. the cost was thirty two cents per pint.

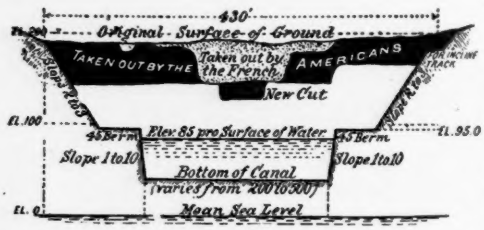
In a recent description of a commercial liquid air plant at Norwich, Conn., [COMPRESSED AIR MAGAZINE, March, 1908.] it was stated by the engineer that the "liquid air

drawn from the system is about seven and a half pounds per h. p. h. of energy expended." The best record at the university test as shown in the table was 164 grams, less than two ounces, per h. p. h. At the liquid air plant at Los Angeles, Cal., the cost of production of liquid air is given as about ten cents per gallon.

ALL ABOUT THE PANAMA CANAL

The following from the *Sphere*, London, is, with its accompanying cut, a marvel of conciseness and clearness:

Since May 4, 1904, the Americans having bought for a sum of about £8,000,000 all the rights and property in the derelict French company, have been in possession of the works and have continued operations on a truly gigantic scale in face of the innumerable difficulties which beset all works in a tropical climate. The chief difficulties which the new proprie-



SECTION OF CULEBRA CUT.

tors have had to encounter may be divided broadly into three sections: (1) The problem of health and hygiene; (2) the obtaining and maintenance of a sufficient force of laborers; (3) the engineering problems connected with the undertaking. The control of the river Chagres, with its sudden and enormous floods, has been one of the cheap difficulties to be contended with, and large controlling works and diversions will have to be made to enable the dam to be built. Double sets of three locks in flight capable of accommodating vessels of 1,000 ft. in length and 100 ft. in width will carry the vessels from sea-level up to the great Gatun Lake, which will have an area exceeding 170 square miles. The navigation channel through this lake will have a minimum depth of 45 ft. and a width at bottom of from 1,000 ft. at Gatun down to 200 ft. through the Culebra cutting, the narrowest part of the canal. At Pedro Miguel, a distance of about 10 miles from the Pacific entrance, the summit level will end, and a descent of 30 ft. will be made by means of a lock to a channel of some 500 ft. in width, extending as far as Miraflores. Here two more locks will lower vessels to the Pacific sea-level. From Miraflores a width of 500 ft. is maintained until the Pacific entrance is reached.

WELDING LOCOMOTIVE FRAMES*

By A. W. McCaslin.

On the Pittsburgh & Lake Erie Railroad we repair some of the engine frames, as many others do, without removing them from the engine and, as far as superficial examination of the completed job would indicate, we have very good results. I do not say that we weld these frames, for, like Mr. Uren, I do not consider that such an operation, made without a lap of some kind, deserves the name weld. In fact, this butting of frames is simply a burlesque on proper welding. I have satisfied myself as to the virtue of this so-called weld by making several in the shop, granting them many advantages that cannot be offered on an engine, and have found that they would invariably separate, showing very little resistance to a light crosswise blow under a small steam hammer. The breaks show that a union of the metal had been effected, but also show a very feeble tenacity; yet, knowing these facts, we are very much in favor of repairing frames this way, wherever it is possible to spread the frame and take the heat, as it frequently keeps the engine in service until the times comes for general repairs, and this means quite a saving.

We have what we think are splendid burners, and build a very satisfactory furnace with standard size fire brick. Mr. Shoenberger, foreman blacksmith in the Ft. Wayne shop at Pittsburg, kindly furnished me the original design for both of them. They are illustrated in the sketch. I build the furnace with the bottom inclined as shown on blue print, making it about 1 in. lower at its center than at the fuel holes at the ends. Have also added a small slag hole at the center near the bottom, so the slag will not gather and be blown up against the frame. We use two burners, and

*From a paper before the International Railroad Master Blacksmith's Association.

crude and carbon oil as fuel, and take a very slow heat. The bottom, inclined as mentioned, helps to prevent the wasting of the bottom side of the frame and gives the heat a start to return over the top of the frame and out the peep hole. When the heat is complete the

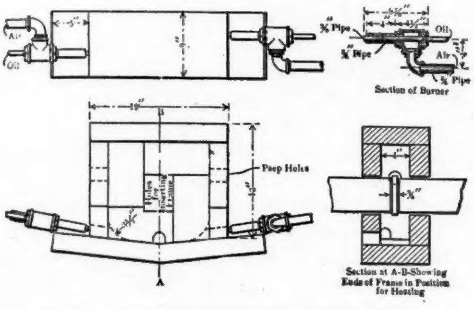


FIG I, FURNACE AND BURNER FOR WELDING LOCOMOTIVE FRAMES.

furnace is pushed into the pit and the work completed with light sledges.

I do not approve of making the side V weld under a heavy steam hammer without using a channel tool. The work will be satisfactorily performed, however, if done under a small steam hammer with light blows, or with heavy sledges. In this case the laid in piece should not be made with the overhang cut too close to the frame. Side heats should be drawn well up to the point of the V piece, and this stock driven back into the weld, at the same time a lap being formed where it is much needed, that is, at the ends of weld on the top and bottom of the frame.

If the side V weld is made in a frame under a heavy steam hammer there should be a heavy channed tool placed on top. This tool should be 8 in. wide, 2½ in. deep, and ½ in. longer in the crown, and ¾ in. longer at the mouth than the cross section of the frame, that it may release readily. It will shear off the extra stock, prevent the laid in piece from lengthening endwise, and will drive it back into the weld, thus forcing it against the walls of the V, and lengthen the lap lengthwise the frame. A second heat should be taken on the laps, in order that there may be no hole or opening at the points of the weld. This is not only the most convenient weld to make in repairing frames, but it is the best.

We sometimes make, in front sections of frames and in large hammer piston rods, what we call a lap and V weld; we flatten the end

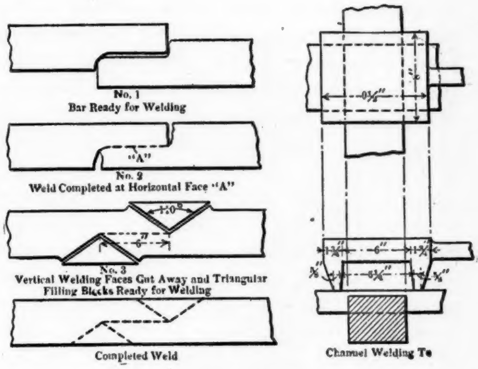
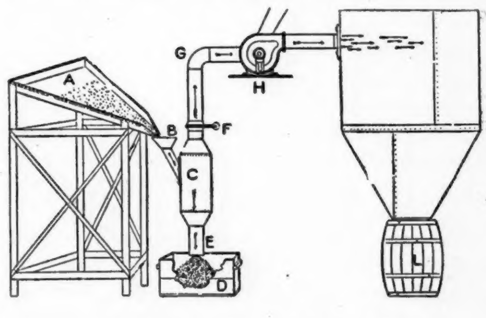


FIG II, LAP AND V WELDS AND CHANNEL TOOL FOR HEAVY HAMMER WORK.

of each piece nearly one-third, make the lap and weld as shown on the sketch, then drive back the end of the laps and lay in a V; this insures a solid center and a solid side opposite each V. It also throws the laid in pieces about 6 in. apart. This weld will elongate evenly when being reduced, and will not slip or shear as the ordinary lap or V weld will. The drawing clearly shows how this type of weld is made.

SEPARATING SAWDUST OR LEATHER FROM SMALL TUMBLED ARTICLES

Tumbling removes sharp edges and scratches from small metal goods. The first tumbling is with sand or gravel, or sometimes steel slugs are used. The articles are then tumbled with leather or saw dust to give the first finish and then they must be separated and cleaned. The



SEPARATING TUMBLED WORK.

sketch here given of apparatus for the purpose comes from The Brass World.

There is a trough of wood *A*, lined with sheet zinc and inclined toward the funnel *B*. This trough is to receive the articles as they

come from the tumbler and is inclined so that they may be readily pushed into the funnel by hand. The funnel B is rigidly attached to a pipe, C, which tapers down at E. Both the funnel, B, and the pipes, C and E, are made of tin or galvanized iron. The pipe C is about 8 in. in diameter, and E is about 6 in. On the top of C the pipe is again tapered to 6 in. and a slide blast gate, F, is placed to control the blast. At G the pipe turns and is connected with an exhaust fan, H. The other end of the fan or the exhaust side is connected with a large sheet iron collector of the usual type. This is the well-known appliance used for collecting buffings, sawdust, etc., when an exhaust fan is used.

A box or other receptacle, D, is used to catch the cleaned articles. A barrel, L, receives the sawdust or leather. To clean a mixture of small articles and sawdust, it is first dumped into the trough A. This is not so inclined that the articles will slide into the funnel alone, but they must be pushed with the hands. As they pass through the funnel B and fall down through the pipe C, the air that is sucked up by the fan removes the sawdust, which is carried over into the collector, and the articles cleaned fall into the box D.

PNEUMATIC SULPHUR MINING

The French process of obtaining sulphur is a highly interesting development of practical science. The latest improved and most successful method is briefly described as follows in Mining Science:

A well is driven through the various strata to the sulphur-impregnated beds in much the same manner as is usual in sinking wells for oil and gas. In each well there are placed concentrically four lines of pipe having diameters ranging from 10 in. to 1 in. Superheated water and hot air is forced down the pipes and the spaces between them to melt the sulphur and to bring it to the surface. The hot water flows down between the two outer pipes, which are respectively 10 in. and 6 in. in diameter, and passes into the limestone, melting the sulphur. The quantity of sulphur melted and the range of action of the water depend on the temperature of the water and on the pressure at which it is supplied. The heavy, melted sulphur runs back into the sump around the well pipe, which it enters through holes provided for this purpose. Hot, compressed air is forced down through the smallest or 1-in. pipe and at the bottom of the well mixes with the melted sulphur and forms an aerated mass sufficiently low in specific gravity to allow the water pressure to elevate the melted sulphur to the surface, where it is discharged into large rectangular vats constructed of rough planking. The dimensions of the vats vary somewhat, but they are made as large as 350 ft. by 250 ft. by 40 ft., and some of them are so arranged that railroad trains can pass between them. The vats are filled as an ordinary water tank would be, but the viscosity of the sulphur as it cools prevents the formation of perfectly horizontal layers, and the flow of sulphur is being constantly deflected to different parts of the vat. In this manner cooling, solidification and feeding go on simultaneously. The hardened sulphur is broken up by workmen either by pick, crowbar and shovel, or by blasting.

A CUT-OFF AND WHAT IT CUTS OFF

Railroad lines as first laid out are often far from the best that might be, on account of the limitations of practical economy. As earnings accumulate improvements may be made giving increased advantage to the system. One of these costly, but ultimately cheap, corrections of original plans is the 28 mile cut-off on the main line of theLackawanna Railroad, which has been lately put under contract, and will effect a great reduction in curvatures and grades, besides actually shortening the line 11 miles. The present line has a maximum grade of 60 ft. to the mile, while that of the cut-off will not exceed 29 ft., and the total saving in curvature will amount to 1,560 degrees. There will be no grade crossings and no tunnels on the cut-off, so that altogether the advantages secured are numerous and important.

The principal feature of the cut-off will be an embankment 2½ miles long with an average height of 90 ft. This, said to be the largest railway embankment ever made, will contain 6,625,000 cu. yds. of material. There will also be a cut requiring the excavation of 541,000 cu. yds. of solid rock. This cut will be ½ mile long and will attain a depth of 132 ft. There will be required in all 13,000,000 cu. yds. of embankment and 13,154,500 cu. yds. of excavation, of which 4,293,500 cu. yds. will be rock.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - - - - Editor
FRANK RICHARDS, - - Managing Editor
L. I WIGHTMAN, - - - Business Manager
H. L. KEELY, - - - - Circulation Manager

PUBLISHED BY THE

Compressed Air Magazine Company
Easton, Pa.

New York Office—Bowling Green Building.
London Office—114 Queen Victoria Street.

Subscription, including postage, United States and Mexico, $1.00 a year. Canada and abroad, $1.50 a year. Single copies, 10 cents.
Those who fail to receive papers promptly will please notify us at once.
Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Entered as second-class matter at the Easton, Pa., Post Office.

Vol. XIII. NOVEMBER, 1908. No. 11

CONTENTS

NOT A HOUSE ORGAN

The following from *Engineering News*, explains itself:

Sir: We regret to note, in your issue of Sept. 17, a reference to "Compressed Air Magazine" as the "house organ" of the Ingersoll-Sergeant Drill Co.—more correctly the Ingersoll-Rand Co. This is an error which we believe you will be glad to correct.

"Compressed Air Magazine" is not, and has never been, the "house organ" of any manufacturing concern. Established in 1896, it has since that time been published as an independent trade journal, owned and edited by the President of the Ingersoll-Rand Co.

It is not issued to exploit any machine of any manufacturer. Its aim is the development of a vast field of engineering industry. It is the exponent of a distinct branch of engineering science and is the only publication in the world exclusively devoted to the subject of compressed air in all its applications. Its list of paid subscribers covers every state and territory in the Union and more than thirty foreign countries. Its policy is that of the broadgage technical journal, not for a moment that of the subsidized "house organ."

Trusting that you will set this matter right before your readers, we are,

Very truly yours,
"Compressed Air Magazine,"
Lucius I. Wightman,
Treasurer and Business Manager.
11 Broadway, New York City, Sept. 18, 1908.

BOOSTING THE LITTLE COMPRESSORS

The ultimate power economy of the Electric Air Drill, in the operating of which, as our readers will remember, the electric current is transmitted to the *pulsator*—not compressor—close to each individual drill, has led to some promulgation of the proposition that it would be generally profitable where drills or other air operated tools are installed in mines or elsewhere to use small electric driven compressors close to the work instead of installing large compressors in the power-house, with suitable pipe lines. In advocating this idea Fearnside Irvine, before the Institute of Mining and Metallurgy, says some rather astonishing things. For instance:

"Small compressors, with small cylinders, whose cubical contents bear a very much smaller relation to the cooling surfaces of the cylinder walls and ends than is possible in larger sizes, are, especially when single-acting, very efficiently cooled; their piston speed in compression is also very low. Take, for instance, a single-acting cylinder with 9 in. stroke and 10 in. diameter, 300 r. p. m., cooled in jacket and head, the cooling surface would be 361 sq. in., the cubical content 706=1 sq. in. to 2 cubic content. In a cylinder 48 in. stroke by 22 in. diameter the contents are 23,000, the cooling surface 3312=1/7.

"Again, the speed of compression at 75 r. p. m. for the larger compressor=600 ft. per min., and for the smaller compressor 225 ft. per min.; thus, the time in contact in the smaller cylinder=2.6 times that of the larger cylinder, and the surface, 3½ times as large,=9¼ times more cooling effect. So far as efficiency is concerned there is little difference between the two, and the small compressor working underground is a distinct advance upon the working of the large one on the surface."

It is necessary first to correct some of these figures. The content of the larger cylinders, one stroke, is: $22^2 \times .7854 \times 48 = 18{,}246$ cu. in., instead of 23,000, and the cooling surface—the interior surface of cylinder and head—is, for the cylinder: $22 \times 3.1416 \times 48 = 3317$ sq. in., and for the head $22^2 \times .7854 = 380$ and $3317 + 380 = 3697$, instead of 3312.

The actual ratio of "cooling surface" is, for the smaller cylinder: $361 \div 706 = .511$ and for the larger cylinder: $3697 \div 18{,}246 = .202$, or 1/5 instead of 1/7. The ratio of cooling surface of the smaller cylinder to that of the larger cylinder, then, is: $511 \div .202 = 2.53$, or 2½ times instead of 3½ times.

The assumptions and deductions as to the time of contact of the air in the two cylinders are entirely wrong. With the small compressor running at 300 r. p. m., the time for the half stroke would be 1/600 min., and the time for the half stroke of the larger compressor would be 1/150 min., or four times as long; then, with the larger compressor having four times the advantage as to time, and the smaller compressor having 2.53 times the advantage as to cooling surface we have $4 \div 2.53 = 1.58$, which shows the preponderance in favor of the larger compressor.

Now, we did not originate and are not responsible for this line of investigation. We are inclined to regard it as an absurdity all through. As a matter of fact, the possibility of cooling the air during the compression stroke can only occur during the latter part of the stroke. During the entire intake stroke and for a portion of the compression stroke the air must necessarily be heated rather than cooled, as the cylinder surfaces must be somewhat warmer than the incoming free air, and it is no wonder that experience actually shows very little cooling of the air during compression as the effect of water jacketing, and that each compression must be regarded as practically adiabatic. This is not saying that water jacketing is not necessary, as it certainly is so as a means of keeping the surfaces cool enough to permit proper lubrication.

The above illustrates the fallacious lines of "argument," which are being promulgated for the multiplying and localizing of small compressors in mines, and elsewhere as preferable to large centralized and concentrated plants. It is mostly talk, after all, as the practice is not being adopted, and is not likely to be where there exists sufficient experience to dictate.

COSTS AND OTHER CONDITIONS OF ELECTRIC AND COMPRESSED AIR TRANSMISSION

The following letter, which speaks for itself, we reprint verbatim from a recent issue of *Mining and Scientific Press*, San Francisco.

Sir—Referring to an article entitled "Underground Air-Compressors," in your issue of August 1, I wish to point out what I consider to be some misleading statements. To quote from the article: "The underground compressors, taking electric power at practically the same potential as a compressor at the surface, had the advantage of saving, first of all, the capital-cost of the pipe-lines, and was thus able to generate compressed-air at a lower pressure . . . (because of the loss of pressure due to transmission in the pipe-lines). This statement would lead one to suppose that an electric transmission-line costs practically nothing compared to the cost of one for transmitting the same power in the form of compressed air. This is not by any means the first time I have seen this asserted, and never have I seen it contradicted.

As a matter of fact, judging from my own

experience, the electric transmission-line will cost more, in most mines, than that for transmitting air. This may not be the case on the surface, where electricity can be transmitted at a high potential over small bare wires carried on poles, while the air-pipe lines have to be buried, but underground-conditions in most mines are quite different. If an electric transmission line is expected to be permanent in a wet mine, especially when there is acid in the water, all conductors must be in the form of lead-covered cables, and these cables must be further protected from mechanical injury by either steel or wooden armor. This I have learned by sad experience to be true, even when the current is carried at a low voltage. Underground rubber-covered wires carried on glass insulators will, after a while, leak as much power as a very poorly constructed air-line, and the wires will break wherever they come under a drip. At the mine with which I am at present connected there is an installation of electric and air-driven pumps, side by side, of about the same capacity, affording an excellent opportunity for comparison in the costs of their respective transmission-lines, 1600 ft. down a vertical shaft. The cost of the cable to supply the current to the electric pumps was some three hundred dollars more than the cost of the pipe supplying air to the compressed-air pumps. It has been stated that the cost of putting in air-pipe is greater than that of electric wiring. This also is sometimes not true, depending very much on circumstances. In the installation to which I have just referred, putting in the electric cable probably cost the most, but an exact account was not kept. An expert had to be obtained from San Francisco to do the splicing. As this could not be done either vertically or in a wet place, the cable had to be spliced before lowering down the shaft. As it was not strong enough to support its own weight, it was necessary to lash it at intervals to a wire cable as it was lowered, and afterward to cut it loose from the cable and clamp it to the shaft timbers. Unforeseen difficulties, such as the two cables becoming twisted around each other, and the fact that the hoisting engine was not strong enough to support the total weight, made the operation anything but as simple as it would seem. Now that they are both in place, if anything happens to the air-line, any miner can replace a length of pipe, but if something should get loose on a cage and rip out a piece of the cable, the consequences might be disastrous and expensive, carrying, as it does, current at 1000 volt. Many people would consider 1000 volt too high a potential for safety in a mine, and if this were reduced to 500 volt, the cable would have cost twice as much as it did.

To take up the question of loss of power in transmission; electric and air-transmission lines should be calculated in exactly the same way, that is, the size of the conductor or pipe should be in either case such that an increase in size would not save enough power to pay the interest on the added investment. Therefore, if the cost of the transmission-lines were the same in the two cases, the loss in power-transmission would be the same. As a matter of fact, it is too often the case that the superintendent or foreman "guesses" that "a four-inch line will carry it" in the case of an air-pipe, but when it comes to an electric line, about which there is something mysterious to many people, the services of an electrician are called in, and he figures the size by formula. But this state of things does not change the facts, that the loss of power in transmission should be no more in the case of compressed-air than in that of electricity, and that it costs about as much for electric-cables as it does for air-pipes. I might add that a poorly constructed electric-line will leak power as well as a poorly constructed air-line.

ARTHUR B. FOOTE.

Grass Valley, Cal., August 3.

A BELATED PATENT

It is a well established fact that certain air compressors, notably those of the piston inlet type, fill their air cylinders on the intake stroke with air fully up to and often slightly above the pressure of the surrounding atmosphere. This is shown by indicator cards, in which the compression line at the beginning of the compression stroke is sometimes coincident with and sometimes perceptibly above the atmosphere line, although through most of the intake stroke it is necessarily low enough to cause the atmospheric pressure to drive it into the cylinder. It is not difficult to account for this complete filling of the cylinder precisely when the reversal of operations occurs, when we consider that the air comes in with

a rush through a long pipe or passage and that the sudden checking of the inflow at precisely the end of the stroke causes the inertia of the rapidly moving column to assert itself by a final thrust upon the air immediately in advance of it.

This being so, it is difficult to understand how any man sufficiently informed to become an inventor in this line could have "invented" precisely this operation and the means by which it is effected a score of years after it has become a familiar accompaniment of established practice, or how the examiners of the U. S. Patent Office could have allowed patent No. 899,706 reported upon the last page of our present issue. This a patent for a "Method of Increasing the Volumetric Efficiency of Cylinder and Piston Machines," the inventor living in London. A single claim of the patent tells the whole story:

"A method of increasing the volumetric efficiency of cylinder and piston machines drawing in charges of elastic fluid," [air] "which consists in causing the suction to occur through a pipe of such length that the pressure at the inlet port at the moment of closing is greater than the normal pressure of the fluid at said port."

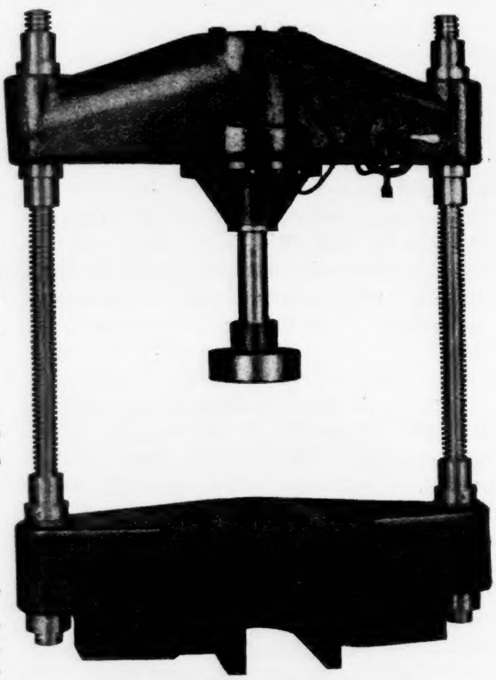
This might very properly have constituted a claim of the original piston inlet patent, so that the value of the patent above referred to must be purely imaginary.

AN INTENSIFYING PNEUMATIC PRESS

The press shown in the half-tone speaks for itself as to its general design and adaptability. It was built originally by the Springfield Machine Tool Company, Springfield, Ohio, for use in its own factory, and is now manufactured for general use in machine shops or elsewhere.

The press as here shown is large enough to take a 40-inch wheel between the uprights. The opening in the centre of the heavy base permits the placing of the work in position without lifting and dropping into a hole. The opening extends back beyond the centre line of the machine. The screws of course allow the head to be raised or lowered according to the height of the work. The head, which is designed to be of equal strength with the base, contains a 12-inch cylinder with 8-inch travel of piston. The piston has three packing rings which effectually prevent air leakage. The heavy shoe on the end of the piston rod has the central portion of its face filled with babbitt, so that work will not be bruised when pressure is applied. The babbitt may of course be renewed whenever necessary.

The press is completely controlled by the valve shown at the right. This directs the air both above and below the piston. Moving the handle from the left hand position the piston may be raised, and a further movement in the same direction shuts off the air. Passing the next point in the same direction



INTENSIFYING PNEUMATIC PRESS.

applies the full pressure to the top of the piston. With the usual shop air pressure of say 80 lbs. the total pressure will be nearly 9,000 lbs.

If a greater pressure than this is desired a further movement of the valve handle in the same direction throws into operation a small, quick acting air pump, which is placed on top of the frame and not shown in the half tone. This pump will raise the air pressure to 250 lbs., and thereby increase the total piston pressure to 27,000 lbs. The pump is a very small arrangement receiving the working pressure upon one side of the pump, the

piston of which automatically reciprocates, carrying on its other end a smaller piston which increases the pressure more than threefold. The pump in principle is similar to a boiler feed pump with steam and water cylinders of different diameters. The press has been thoroughly tested in actual service, and has proved in every respect satisfactory.

MUNICIPAL MUNIFICENCE

After working for a period of 16 years, seven days in the week, as chief engineer at the pumping station of Cedar Falls city water works, H. C. Boyson has been granted a two weeks' vacation by the city council at full pay with the privilege of a month should he so desire. During the sixteen years Mr. Boyson has been in charge of the city pumping station he has worked alternately day and night and has never lost a day because of sickness, accidents or for any other reason. He started in at $40 a month and has gradually been advanced by the city council until he now receives $60.00.—*Midland Municipalities.*

MOIST AIR DRYING

Moist-air drying is growing from the fact that it is becoming understood that it is not the amount of moisture in the air, but the amount more that can be put in, that makes it a drying air. With the fact that each advance in temperature of 25 degrees doubles the capacity of the air for moisture, it may be readily seen that moisture in air of a considerable amount at any given temperature, when that temperature is raised, is no longer a large factor in the capacity of that air to receive more moisture. It also should be borne in mind that water in all its forms, vapor or steam, holds very much more heat for a given volume than will air, therefore hot, moist air holds very much more heat present to supply the needed heat for evaporation than can dry air. Its advantages are very many, not the smallest being the fact that it intercepts the direct heat ray, preventing carbonization of the stock at all stages of the drying, this heat ray, intercepted, also adding to the economy of drying in helping to provide the heat for evaporation, which otherwise is absorbed by the wall, ceiling or floor of the kiln.—*The Wood Worker.*

BUYERS' COMMISSIONS

From the standpoint of the engineer, acting as a purchasing agent or adviser, the case seems to me as clear in the court of honor as it would be in a court of law. He cannot honorably accept a commission from the seller while he is the agent of the buyer. If the custom of the trade permits the giving of such a commission, but not its deduction from the face of the bill rendered, he may, of course, honorably accept it and pay it over to his own employer—that being the only way in which he could secure the minimum net price in his employer's interest—but even in that event he should place his honor beyond suspicion, as, for instance, by demanding the commission in a check to his own order and endorsing the same check to the order of his employer. There may be exceptional cases in which the taking and keeping of a commission is justifiable, but one thing is clear beyond dispute: It is always wrong when it needs to be kept silent.—*John Hays Hammond, Presidential Address at Chattanooga.*

BUBBLES OF GAS SINKING IN A LIQUID

If one were asked to specify a physical law to which there could be no possible exception it might well be that of the rise of bubbles to the top of any liquid. The exception to this, however, has been found. A writer in *Cosmos* says: "We are used to thinking of gases as always less dense than liquids, and, in fact we have never hitherto been able to increase the density of a gas, either by compressing or by cooling, down to the point where it becomes heavier than a liquid in contact with it. This could not take place, of course, if the gas became liquid or dissolved in the liquid. Dr. Kammerliugh Onnes has, nevertheless, accomplished this surprising feat by causing a bubble of compressed helium to descend by its own weight through liquid hydrogen, like a drop of water in oil. He compressed a mixture of hydrogen and helium in a capillary tube plunged into liquid hydrogen. The hydrogen becomes almost entirely liquefied and, if the pressure does not exceed 49 atmospheres, occupies the bottom of almost pure helium, which is floating on the liquid, is seen to descend below it, and to rise again when the pressure is decreased to 32 atmospheres.

RAPID DREDGING

The easiest money I ever earned was when I agreed to dredge the ferry slip of the ——— Transportation Company. They were in a bad plight, telegraphing everywhere for a dredger that could be towed up in a hurry; for the river had silted up their landing slip in their busiest season and it meant a thousand dollars a day to them. In the midst of their excitement, I happened into their office and offered to dredge the slip for $500. "Done," said they, and we signed papers on the spot. Then I went out and hired a big tug for five dollars an hour, backed her into the slip, tied her close and fast, and started the engine. In about a minute that big propeller set up such a current that the silt began floating out of the slip in tons. In two hours I called at their office again, left a good cigar, and got my $500.—*Benjamin Baker in Scribner's Magazine.*

NOTES

The highest mine in the world is the Santa Barbara, Bolivia, South America, which is at an altitude of 18,000 ft. above sea level.

In preparing pure white table salt from rock salt the process employed, from the days of the Romans, has been that of solution and evaporation. An English inventor has devised a process, commercially practicable, by which the salt is purified more directly. The salt is simply melted and then compressed air is driven up through the molten mass. Impurities are separated and deposited and the salt is left white and pure. The salt thus produced is said to be exceptionally fine, and, being anhydrous, does not cake.

The Burlington Railroad has recently bored an artesian well at Edgewater, South Dakota, with highly satisfactory results. A geologist of the United States Geological Survey, who had made a study of the surface outcrops of the region stated that a good supply of water would be found in a certain stratum of rock which lay at a depth of about 3,000 feet. When the bore reached a depth of 2,980 feet water rushed out at the rate of 350 gallons per minute, or about half a million gallons a day, supplying a most urgent need of that section.

The vacuum machine, as used for cleaning carpets and house and office furnishings, is now used also for cleaning horses. The apparatus comprises a vacuum pump with means for driving it, a vacuum tank with gage and separating diaphragm a number of special vacuum combs and connecting pipes and tubing. A horse can be thoroughly cleaned in one quarter the time required by hand.

The rifled oil pipe line of the Southern Pacific Co. in the San Joaquin valley, California, is now in operation for a length of 120 miles. It is to be extended to nearly 300 miles. Reports state it to be entirely successful, with a movement of 17,000 barrels per day (8in. pipe). There are eight pumping-stations on the line. The water which is pumped in forms an outer skin about 1-8 in. thick at the beginning and thicker farther along the line, the oil staying in the interior, due to centrifugal action (as in cream separators).

An act of revenge on the part of an Italian laborer, because he considered he had been dismissed without cause, has cost the government of Baden the sum of $875,000. The government has been constructing a railroad tunnel through the Black Forest Mountains, working in from each end to meet in the centre. It was discovered to-day that the two halves, which should have come together at the village of Forbach, miss each other by twenty-six feet. The reason is a mistake in the survey which arose from the intentional misplacing of a surveying pin by the Italian.

Last year coal was mined in 3,295 mines in Great Britain, as against 3,461 in 1902. The number of coal-cutting machines at work was 1,136 as against 483 the preceding year, a gain during this period of 653 cutters. It is apparent that machines are rapidly growing in favor. The motive power is still a debatable point. In Scotland electricity is the favorite, 171 machines being driven by electricity and 134 by compressed air. In England compressed

air is the favorite, in one district the disparity being as great as 158 compressed-air machines to 94 driven by electricity. The machine-mined coal in 1906 was 10,202,506 tons. One ton in every 25 was mined by machinery.

In a tunnel which is being driven to connect the Rausch Creek workings with the big Brooksile colliery of the Philadelphia & Reading Coal and Iron Company, two men were recently killed by lightning a quarter of a mile from the entrance. The electric connection with the outside was probably through the rails.

A new electro-barograph has been invented to furnish an automatic and audible signal in case of a sudden and dangerous drop of mine pressure. It consists of an aneroid barometer, fitted with three dry cells and a signal bell. The contact-maker may be adjusted at the beginning of each shift, or at any other appointed time. The distance between the pointer and the brush or contact-maker is adjusted to the requirements of each mine. As soon as the bar of the barometer falls a certain distance, measured by the interval between the pointer and the brush, electric contact takes place between the bar and the brush, and the bell rings.

The production of hydrogen by a new and cheap process is reported from Germany in a Consular Report from Chemnitz. The method which has been devised by a German professor, is said to have aroused considerable interest among aeronauts and manufacturers who use hydrogen in the arts. The materials employed in the new process are water, coke and calcium carbide. The first step is the production of water gas, which is obtained by passing steam through a thick bed of red-hot coke, and consists principally of a mixture of hydrogen and carbon monoxide. The latter is removed by passing the water gas over glowing calcium carbide in the form of powder. The carbon monoxide is completely decomposed, uniting with the carbide to form lime and pure carbon, and leaving the hydrogen isolated with an admixture of but one per cent. of other gases.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

SEPTEMBER 1.

897,290. PNEUMATIC EYE-PROTECTOR. ALBERT E. JACOBS, Lancaster, Pa.

1. In a device of the class described, consisting of an eye protector, a frame formed of two adjacent tubular circular eye frames formed with openings in their periphery, a tubular nose-bridge connecting said eye frames, means for connecting said eye frames to flexible piping, and means for supporting said flexible tubes and securing the device to the head of the wearer, for the purpose set forth.

897,356. METHOD OF DRYING AIR FOR BLAST FURNACES. DAVID T. DAY, Washington, D. C.

897,484. PNEUMATIC CONTROL SYSTEM. PHILIP PFORR, Berlin, Germany.

897,491. ACETYLENE - GAS APPARATUS. NILS A. RENSTROM, Omaha, Neb.

897,498. MULTISTAGE PUMP FOR PRODUCING A VACUUM OR COMPRESSING GASES. AUGUST SIEGEL, Berlin, Germany.

897,593. APPARATUS FOR CONTROLLING THE FLOW OF LIQUIDS. JAMES W. COX, Berwyn, Ill.

897,657. ELECTRIC AND PNEUMATIC GOVERNOR. WILLIAM K. RANKIN, Philadelphia, Pa.

897,666. METHOD OF CONTROLLING AIR-SHIPS. MARIO SCHIAVONE, Ferrandina, Italy.

897,676. FLUID-FEEDING-PRESSURE MECHANISM. GEORGE THOMPSON, Mansfield, Ohio.

897,811. AUTOMATIC PNEUMATIC-TIRE INFLATER. ROBERT C. BARRIE, Philadelphia, Pa.

897,813. AIR-GUN. BURTON B. BENNETT, Detroit, Mich.

SEPTEMBER 8.

897,923. PROCESS OF PRESERVING EXPLOSIVES. JULIEN ORTIZ, Greenville, Del.

1. The process of storing explosives to retard their spontaneous decomposition which consits in inclosing a quantity of the explosive in an air tight compartment, rarefying the air in the compartment in contact with the explosive and displacing the withdrawn air with a body of anhydrous air, and then rarefying the body of anhydrous air.

897,958. PNEUMATIC HAMMER. JOSEPH BOYER, St. Louis, Mo.

898,015. AIR-LIFT PUMP. WILLIAM F. SPANGLER, Greenfield, Ind.

898,022. FLUID-PRESSURE BRAKE. CLARENCE A. TRIPP, Los Angeles, Cal.

898,096. AIR BRAKE COUPLING. JOEL H. COLE, Arkansas City, and JOEL R. COLE, Winfield, Kans.

898,135. VALVE-OPERATING DEVICE FOR COMPRESSORS. WILLIAM PRELLWITZ, Easton, Pa.

898,194. AUTOMATIC GOVERNOR FOR PNEUMATIC MOTORS. CHARLES L. DAVIS, Detroit, Mich.

898,214. AUTOMATIC PIPE-COUPLING FOR RAILWAY-CARS. EDWARD E. GOLD, New York, N. Y.

898,264. HYDRAULIC AIR-PUMP. JOHN B. RIDOUT, St. Paul, Minn.

898,343. AIR-LOCK FOR MINES AND TUNNELS. PATRICK H. DURACK, El Paso, *Tex.*

898,363. INTERCOOLER. FRED D. HOLDSWORTH, Claremont, N. H.

898,389. AIR-COMPRESSOR. FREDERICK W. PARSONS, Tarrytown, N. Y.

SEPTEMBER 15.

898,444. APPARATUS FOR SUBJECTING MATERIALS TO THE ACTION OF LIQUID UN-

DER PRESSURE. LEON DETRE, Rheims, France.

1. In an apparatus for subjecting textile or other materials to the action of liquids under pressure, in combination, a reservoir for the liquid, means for maintaining a pressure on the liquid in said reservoir, a vessel for the material and in communication with said reservoir so that the pressure facilitates the penetration of the liquid into or through the material, and means acting independently of the degree of pressure for sucking out the liquid at one side of the material in the vessel, and forcing it in at the other.

898,461. VACUUM-PUMP. WILLIAM P. M. GRELICK, Elgin, Ill.

898,493. ROTARY AIR-PUMP. HARRY M. MONTGOMERY, Chicago, Ill.

898,505. PNEUMATIC HAMMER. THEODORE C. PROUTY, Aurora, Ill.

898,506. APPARATUS FOR THE PRODUCTION OF OZONE. JOHN R. QUAIN, London, England.

898,522. POWER AIR-PUMP. WILLIARD J. SPENCER, Waterbury, Conn.

898,524. DEVICE FOR SUPPLYING FIREMEN WITH FRESH AIR. PATRICK H. SULLIVAN, Detroit, Mich.

898,542. PNEUMATIC - DESPATCH - TUBE SYSTEM. FRANKLIN H. WOLEVER, Chicago, Ill.

898,601. PROCESS OF MANUFACTURING GAS. HAWLEY PETTIBONE, New Rochelle, N. Y.

898,606. AUTOMATIC GOVERNOR FOR FLUID-COMPRESSORS. EDWARD J. ROHRBACHER, Blaine, Wash.

898,612. COMPRESSED-AIR WASHING DEVICE. JOSEPH A. VANCE, Columbus, Ohio.

898,659. COMPRESSOR. HENRY KUEHL, Philadelphia, Pa.

898,679. BRACE ATTACHMENT FOR FLUID-PRESSURE-OPERATED TOOLS. WILLIAM PRELLWITZ, Easton, Pa.

898,702. HAMMER-DRILL. ALBERT H. TAYLOR, Easton, Pa.

898,712. PNEUMATIC VEHICLE-SPRING. TRUMAN G. WILKINSON, South Williamsport, Pa.

898,746. DOUBLE-ACTING WET-AIR PUMP. EMIL JOSSE, Berlin, Germany.

989,761. PNEUMATIC ACTION. HERMANN MEYER, New York, N. Y.

898,775. AIR CONVEYER. EDWIN NORTON, Lake Placid, N. Y.

1. The combination of a sheet or pack rolling mill, an air conveyor for the hot rolled sheets or packs, said air conveyer comprising a casing provided with air ducts constructed so as to direct air from the casing upwardly against the sheets or packs and forwardly in the direction in which the same are to be conveyed, and means for artificially cooling the air before it is discharged against the said sheets or packs being conveyed.

898,856. DRY-PIPE VALVE. POWELL EVANS, Philadelphia, Pa.

898,927. VACUUM MINING DEVICE. JERRY B. RIDDLE, Sacramento, Cal.

SEPTEMBER 22.

899,027. ROTARY AIR - COMPRESSOR. GEORGE F. BURTON, Woodlawn, Ala.

899,101. CONTROLLER FOR PNEUMATIC PUMPS. ELIAS W. CONKELL, Canton, Ohio.

899,110. AUTOMATIC AIR-VALVE. GEORGE D. HOFFMAN, New York, N. Y.

899,225. RESPIRATION APPARATUS. PETER LORD, Worcester, Mass.; Martha V. Lord administratrix of said Peter Lord, deceased.

899,246. AUTOMATIC SANDING APPARATUS FOR FLUID-PRESSURE BRAKES. EDWARD G. DESOE, West Springfield, Mass.

899,263. AUTOMATIC PRESSURE-GOVERNOR. GEORGE M. RICHARDS, Erie, Pa.

899,289. APPARATUS FOR PURIFYING AND HUMIDIFYING AIR. WILLIAM G. R. BREAMER, *Buffalo*, N. Y.

899,427. AIR-BRAKE SYSTEM. JAMES D. NICHOL, Amadore, Mich.

899,458. PUMPING APPARATUS. GEORGE J. MURDOCK, Newark, N. J.

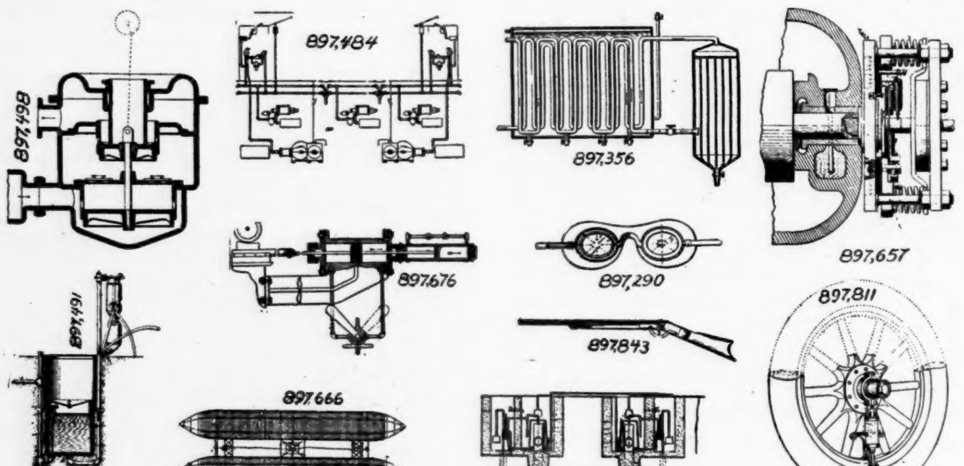
1. In pumping apparatus such as described, an air chamber provided with an inlet and with an outlet, separate from said inlet, for the fluid to be pumped, in combination with a source of supply of pulsations of fluid under pressure, and means connecting the same to the interior of said chamber at a point below the top thereof.

899,462. AIR - VALVE FOR HYDRAULIC JACKS. JAMES W. NELSON and WILLIAM H. MATHERS, New York, N. Y.

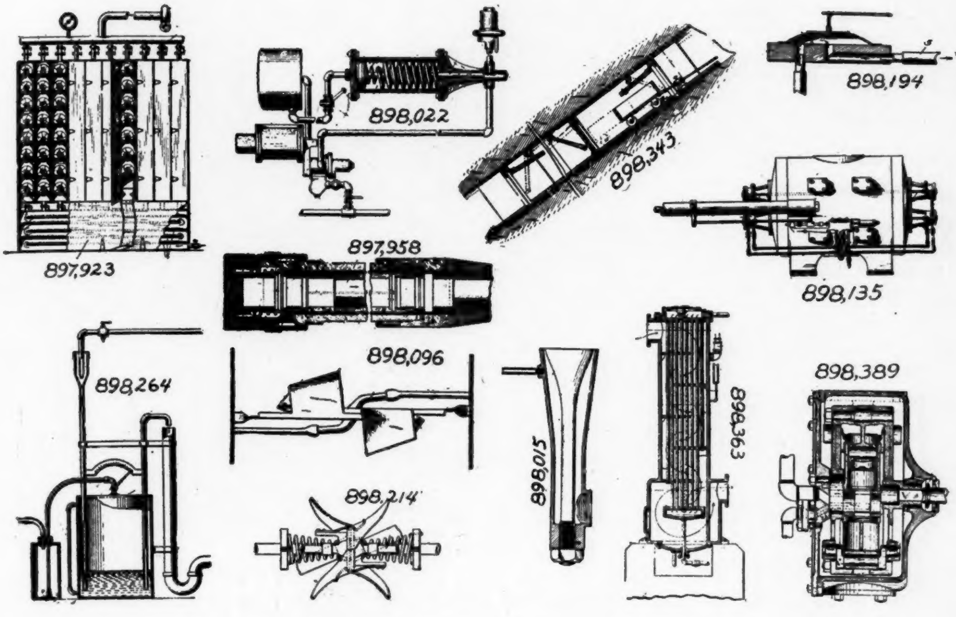
899,480. PRESERVING WOOD. WALTER BUEHLER, Minneapolis, Minn.

12,857. (Reissue). VALVE. WILLIAM H. KLINE, Dunbar, Pa.

1. In a device of the character described, storage reservoir, a fluid compressor provided with a port to admit fluid under pressure from the



PNEUMATIC PATENTS, SEPTEMBER 1.



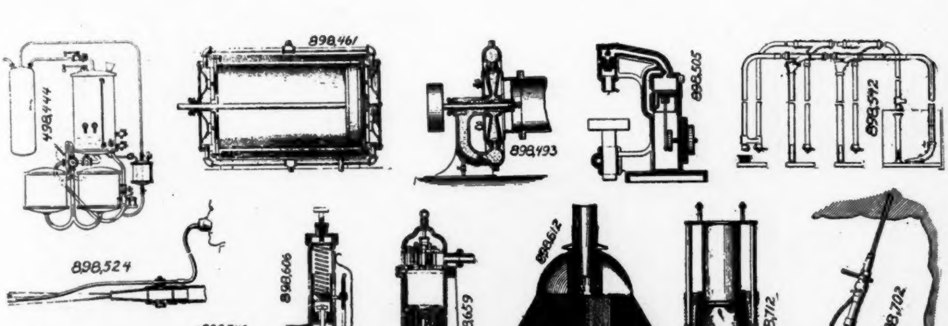
PNEUMATIC PATENTS, SEPTEMBER 8.

compressor to the reservoir, a port-closure adapted to control the flow of fluid through the port and from the compressor to the reservoir, a piston adapted to operate said port-closure, a cylinder in which said piston is mounted to reciprocate, a pipe disposed to admit a fluid under pressure from the compressor to the cylinder to operate the piston, a valve located in said pipe, and means for admitting a fluid from the reservoir to hold the said valve normally closed, the parts being so disposed that, when the tension of the fluid in the compressor exceeds the tension of the fluid in the reservoir, the valve is opened to admit fluid to the **cylinder.**

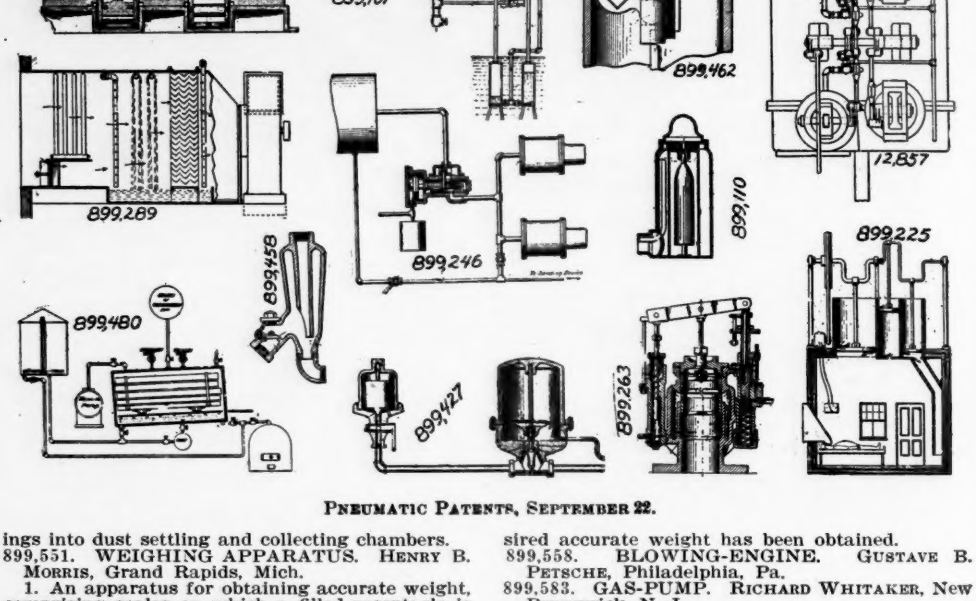
SEPTEMBER 29.

899,508 MEANS FOR VENTILATING MINES AND REMOVING DUST AND GASES THEREFROM. FRANK T. BYERS, Mount Pleasant, Pa.

1. Apparatus for the ventilation of mines and the removal of dust and gases therefrom, comprising means for closing the entrance of the mine, means for reducing the atmospheric pressure therein, means for introducing air at a higher pressure into the inner ends of the chambers or rooms, thereby causing drafts from the rooms into the headings of the mine, and means for conducting the dust and gases from the head-



PNEUMATIC PATENTS, SEPTEMBER 15.



PNEUMATIC PATENTS, SEPTEMBER 22.

ings into dust settling and collecting chambers.

899,551. WEIGHING APPARATUS. HENRY B. MORRIS, Grand Rapids, Mich.

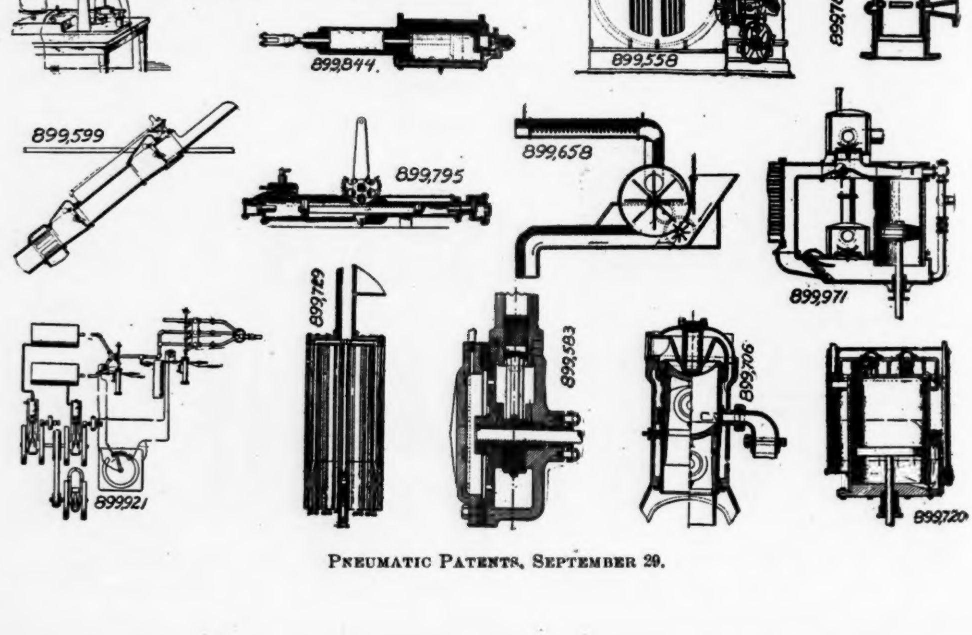
1. An apparatus for obtaining accurate weight, comprising scales on which a filled receptacle is supported, means adapted to be inserted into and withdrawn from the upper part of the receptacle while on the scales to withdraw surplus material from the upper surface thereof, and devices for arresting the withdrawing action when the desired accurate weight has been obtained.

899,558. BLOWING-ENGINE. GUSTAVE B. PETSCHE, Philadelphia, Pa.

899,583. GAS-PUMP. RICHARD WHITAKER, New Brunswick, N. J.

899,584. VALVE FOR GAS-PUMPS. RICHARD WHITAKER, New Brunswick, N. J.

899,599. SENDING MECHANISM FOR PNEUMATIC-DESPATCH SYSTEMS. CHESTER S. JENNINGS, Boston, Mass.



PNEUMATIC PATENTS, SEPTEMBER 29.